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ADDITION OF FLEXIBLE BODY OPTION TO THE TOLA COMPUTER PROGRAM

Part I - Final Report

By J. W. Dick and B. J. Benda

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ABSTRACT

This report describes a flexible body option that was developed and added to the Takeoff and Landing Analysis (TOLA) computer program. The addition of the flexible body option to TOLA allows it to be used to study essentially any conventional type airplane in the ground operating environment. It provides the capability to predict the total motion of selected points on an aircraft including the effects of the elastic motion of the airplane. The analytical methods incorporated in the program and operating instructions for the option are described. A program listing is included along with several example problems to aid in interpretation of the operating instructions and to illustrate program usage.

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1. INTRODUCTION

This report describes the flexible body option of the airplane Takeoff and Landing Analysis (TOLA) computer program. This option was developed by McDonnell Douglas Astronautics Company-East under NASA Contract NAS1-13259 for investigation of aircraft response in a ground operating environment. The response data provided can be used for evaluation of structural fatigue life, ground handling characteristics, passenger comfort and vehicle loads.

The original TOLA computer program was developed by Air Force Flight Dynamics Laboratory personnel and is described in References (1) through (4). This formulation provides a complete simulation of the aircraft takeoff and landing problem. Effects simulated include aircraft control and performance during glide slope, flare, landing roll and takeoff roll for an aircraft with a rigid airframe.

The flexible body option added to TOLA provides the additional capability to predict the total motion of desired points on the aircraft including the effects of the elastic motion of the airframe in the ground operating environment. A block diagram of the TOLA computer program with the flexible body option is shown in Figure 1-1.

This report describes: the analytical methods used to formulate the flexible body effects; the changes and additions made to the TOLA computer program; the use of the revised program; and the check cases run to verify program results.

User's and programmer's documentation (Reference 5) provides additional information about the TOLA program flexible body option.

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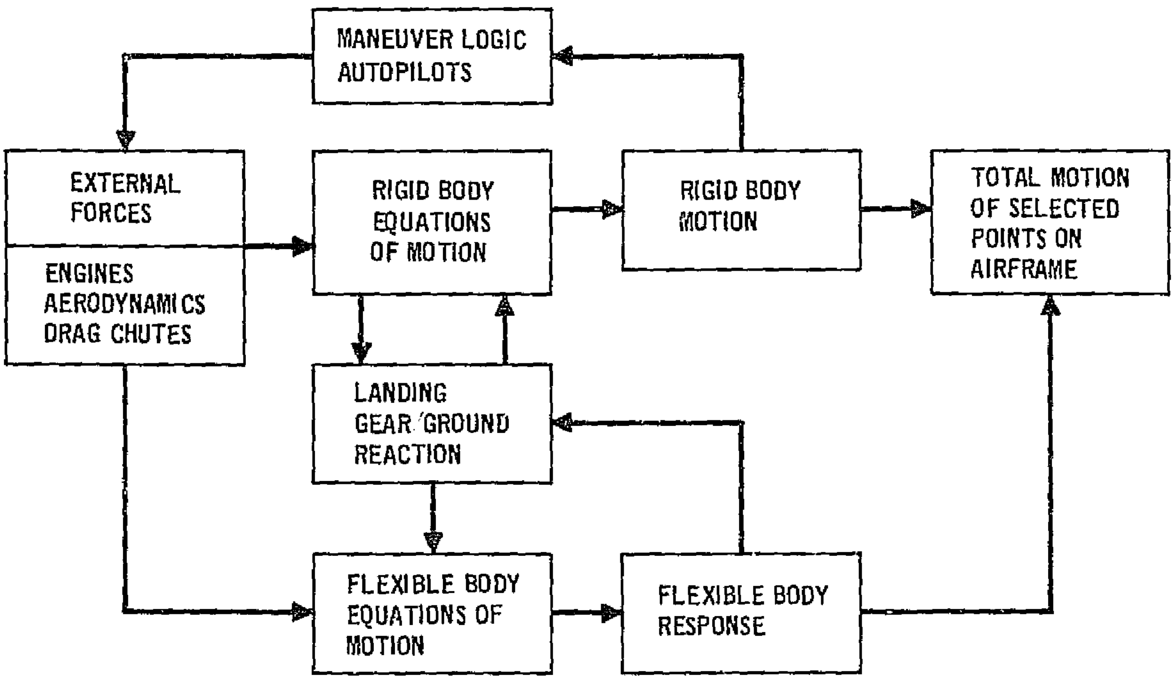

FIGURE 1–1 BLOCK DIAGRAM OF TOLA COMPUTER PROGRAM WITH FLEXIBLE BODY OPTION

2. FLEXIBLE BODY OPTION CAPABILITIES

The TOLA computer program permits a comprehensive simulation of the airplane takeoff and landing problem. The addition of the flexible body option to TOLA allows it to be used to study essentially any type of aircraft in the ground operating environment. TOLA's capabilities, assuming a rigid aircraft, are discussed in detail in Reference (4). All of those capabilities are retained in the modified version of TOLA. For the sake of completeness, most of them are repeated in the description of the flexible body option below.

2.1 Aircraft Simulation - The flexible body option version of TOLA can simulate an aircraft with up to four engines and a maximum of five landing gears. The airframe, defined as the airplane minus its landing gears, may be idealized as either a rigid body or a flexible body. Basically, this modified version of TOLA has two options; a rigid airframe option and a flexible airframe option. In the flexible airframe option, the flexibility is represented by the superposition of free-free vibratory modes on the rigid body motion. From one to twenty modes may be included to represent the airframe flexibility. These modal data must be input to the program. Airframe time history data printed out include 1) rigid body displacements, velocities and accelerations at the center of mass; 2) elastic body displacements, velocities and accelerations at up to 20 points on the airframe; and 3) total (rigid body plus elastic body) velocities and accelerations at these same points.

The dynamic effects of a maximum of five independent landing gears are simulated. The landing gear idealized, shown in Figure 2-1, is a double air chamber oleo strut with balloon tires, similar to that used on the C-5A aircraft; the secondary piston and air chamber can be eliminated from the problem, if desired. Each of the struts must lie in a plane parallel to the aircraft plane of symmetry, but the strut axis may be nonperpendicular to the longitudinal aircraft axis. The position and velocity of each strut and secondary piston are obtained by numerical integration subject to position constraints (for example, the main strut must move within the limits of the fully extended position and strut bottom position). Orifice coefficients can depend on the direction of oil flow through the orifice. Wing-gear root

friction (i.e., binding friction between moving strut and its support at the wing) is also included. Tire forces depend upon tire deflection and a coefficient of friction which is a function of "percent skid", the ratio of tire footprint velocity to axle velocity. The simulation is designed to consider that the gears may bounce off and back onto the runway. Complete information on the dynamic state of the landing gears is printed out by TOLA.

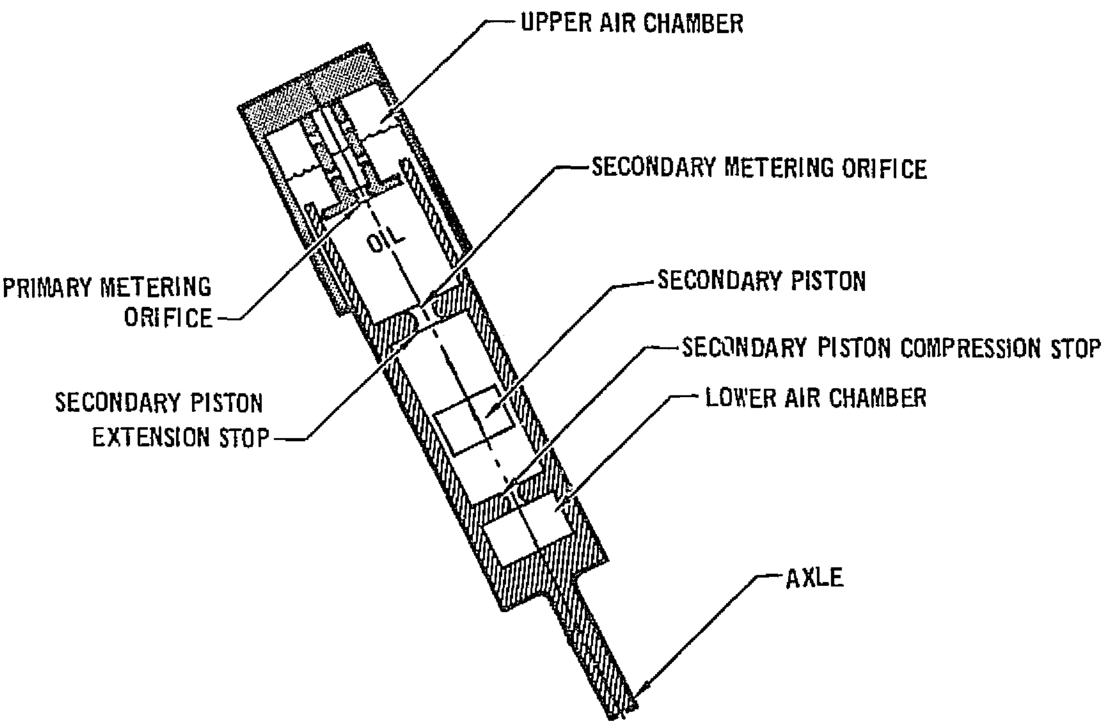

FIGURE 2-1 LANDING GEAR STRUT CONFIGURATION

The simulated aircraft, as represented by the airframe rigid and flexible body equations of motion and the strut, strut secondary piston and wheel equations of motion, may be subjected to time varying forces, ground reactions and maneuver commands.

Forces in the problem simulation include engine thrust, aerodynamics including ground effects, drag chute forces, landing gear tire-ground reaction and braking forces. These forces may be varied and/or staged within the aircraft's capability by the maneuver logic and autopilot simulations discussed in the next section.

2.2 Autopilot Simulation - The function of the autopilot is to specify the aircraft's control variable magnitudes that result in the required aircraft performance during glide slope, flare, landing roll, and takeoff roll. The autopilot simulation is described in detail in Reference (2). Since the capabilities of the autopilot are not changed in the flexible body option of TOLA, they will be only summarized here.

Figure 2-2 shows a simplified block diagram of the autopilot simulation. The maneuver logic utilizes information on the state of the aircraft obtained from solution of the airplane equations of motion to compute state errors. If necessary, it defines a corrective maneuver by specifying, for example, angle of attack, roll angle, thrust levels, and braking values. The maneuver logic also specifies the staging of events such as spoiler activation, kill power, engine failure, thrust reversal, drag chute deployment, brake activation and brake failure.

The maneuver logic output is used by the pitch, yaw, roll, throttle and braking autopilot to determine desired values of the control variables. These values, after adjustment for simulated control system lags, become the actual control variable magnitudes that determine the aircraft response. Complete information on the state of the maneuver logic, the five autopilots and the control response are printed.

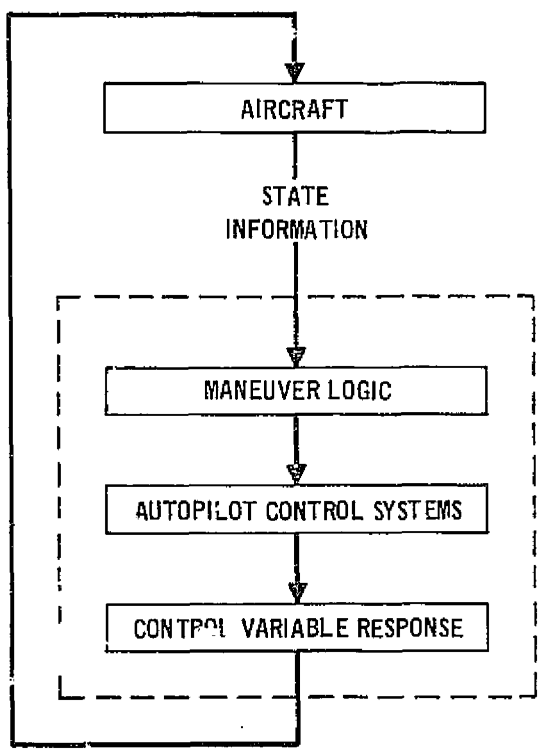

FIGURE 2–2 AUTOPILOT SIMULATION

3. FLEXIBLE BODY OPTION

The flexible body option version of TOLA provides the capability to predict the total motion of an aircraft including airframe elastic effects and landing gear dynamics. It can simulate an aircraft with up to five landing gears and four engines considering the airframe to be either rigid or flexible. The analytical methods used to develop the computer program are presented in Section 3.1. Organization of the computer program is presented in Section 3.2, operating instructions in Section 3.3 and demonstration and verification problems are presented in Section 3.4. A listing of the program is given in Appendix A.

3.1 Analytical Methods - Analytical methods used to develop the TOLA flexible body option are presented below. Included are discussions of coordinate systems, equations of motion, and simplifying assumptions.

3.1.1 Coordinate Systems - Four types of coordinate systems, as shown in Figure 3-1, are used to locate the aircraft as a function of time. These consist of two coordinate systems fixed relative to the earth, and two systems moving with the airplane. These right-handed, orthogonal axes systems are defined as follows:

Inertial Coordinate System (X_g, Y_g, Z_g) - This is a coordinate system fixed relative to the earth's local acceleration of gravity vector. The Z_g axis is directed along the local gravitational vector with the X_g and Y_g axes perpendicular to it.

Runway Coordinate System (X_R, Y_R, Z_R) - This is an earth fixed coordinate system located a distance R_{gR} along the X_g axis. Y_R is parallel to Y_g and the runway has an elevation angle, E_R, relative to the X_g axis. The runway length is R_L.

Body Coordinate System (X_o, Y_o, Z_o) - This is a coordinate system moving with the airplane and fixed at the center of mass. The mass center is located Y_o is positive outboard in the right wing direction and Z_o is positive downward. The airplane's angular positions are defined in terms of the three Euler angles Ψ, Θ, and ϕ. Definition of the aircraft's angular position relative to the inertial axes system is based on a specific order for the Euler angle rotations. The order required for these rotations consists of an initial rotation, Ψ, about the Z_g axis, followed by a rotation, Θ, about the displaced Y_g axis and finally by a rotation, ϕ, about the direction of the

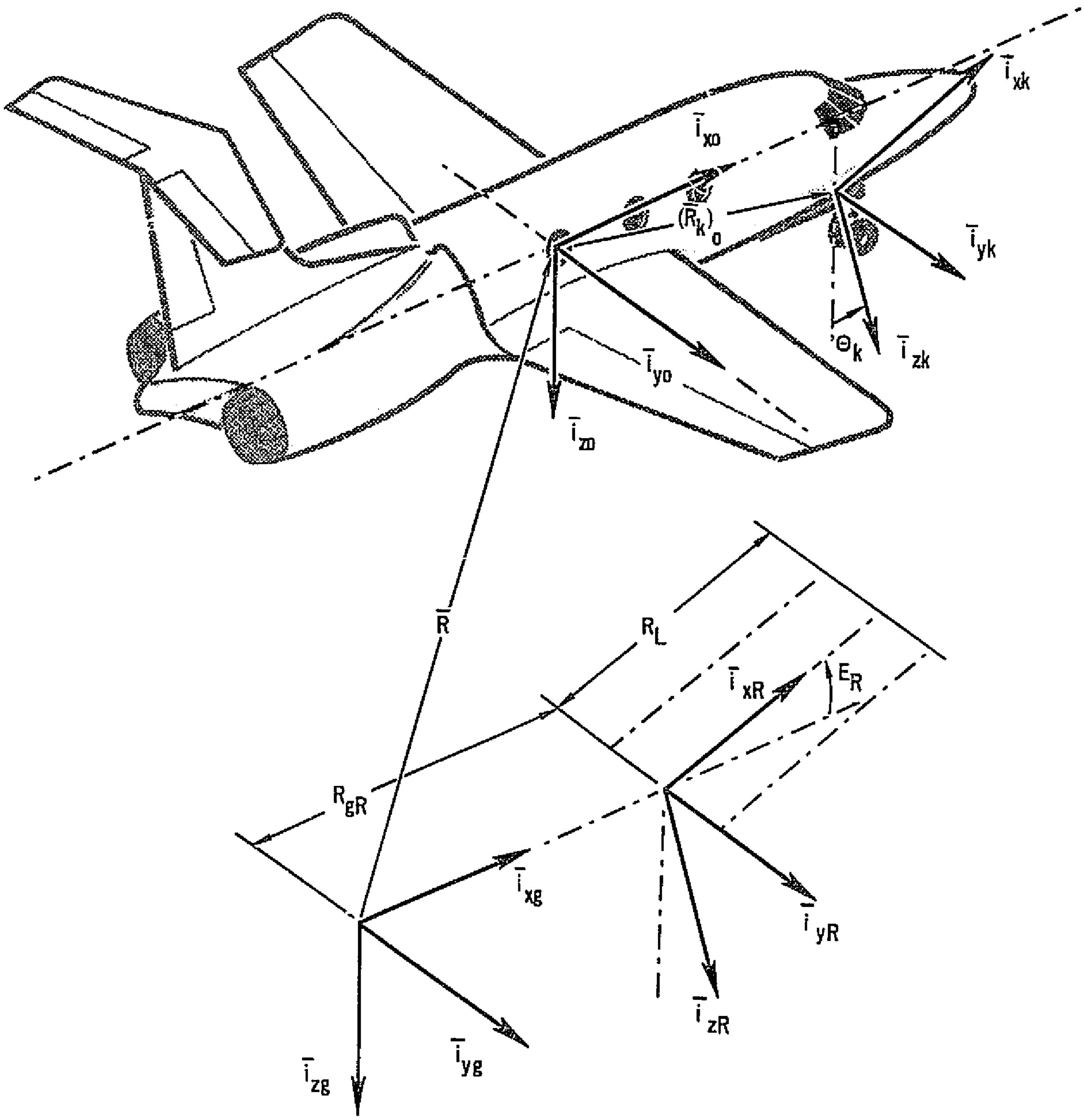

FIGURE 3–1 COORDINATE SYSTEMS

displaced X_o axis resulting from the two previous rotations. When all three of the Euler angles are zero, the airplane or body coordinate system is aligned with the inertial coordinate system.

Strut Coordinate Systems (X_k, Y_k, Z_k) - These are coordinate systems moving with the airplane and located relative to the body coordinate system by the vector $(\overline{R}_k)_o$. Y_k is parallel to Y_o. Z_k and X_k are rotated about tne positive Y_o axis by the angle Θ_k such that the direction of gear movement is along the Z_k direction.

The runway coordinate system is related to the inertial coordinate system by the following relationships:

$$\begin{Bmatrix} X_R \\ Y_R \\ Z_R \end{Bmatrix} = \begin{bmatrix} R_{G11} & 0 & R_{G13} \\ 0 & 1 & 0 \\ R_{G31} & 0 & R_{G33} \end{bmatrix} \begin{Bmatrix} X_g \\ Y_g \\ Z_g \end{Bmatrix} \qquad (3\text{-}1)$$

where $R_{G11} = \cos E_R$

$R_{G13} = - \sin E_R$

$R_{G31} = \sin E_R$

$R_{G33} = \cos E_R$

The body coordinate system is related to the inertial coordinate system by the following relationships:

$$\begin{Bmatrix} X_o \\ Y_o \\ Z_o \end{Bmatrix} = \begin{bmatrix} l_1 & l_2 & l_3 \\ m_1 & m_2 & m_3 \\ n_1 & n_2 & n_3 \end{bmatrix} \begin{Bmatrix} X_g \\ Y_g \\ Z_g \end{Bmatrix} \qquad (3\text{-}2)$$

where $l_1 = \cos \Theta \cos \Psi$

$l_2 = \cos \Theta \sin \Psi$

$l_3 = - \sin \Theta$

$m_1 = \sin \phi \sin \Theta \cos \Psi - \cos \phi \sin \Psi$

$m_2 = \sin \phi \sin \Theta \cos \Psi + \cos \phi \cos \Psi$

$m_3 = \sin \phi \cos \Theta$

$n_1 = \cos\phi \sin\Theta \cos\Psi + \sin\phi \sin\Psi$

$n_2 = \cos\phi \sin\Theta \sin\Psi - \sin\phi \cos\Psi$

$n_3 = \cos\phi \cos\Theta$

The strut coordinate systems are related to the body coordinate system as follows:

$$\begin{Bmatrix} X_k \\ Y_k \\ Z_k \end{Bmatrix} = \begin{bmatrix} A_{k11} & 0 & A_{k13} \\ 0 & 1 & 0 \\ A_{k31} & 0 & A_{k33} \end{bmatrix} \begin{Bmatrix} X_o \\ Y_o \\ Z_o \end{Bmatrix} \qquad (3\text{-}3)$$

where $A_{k11} = \cos\Theta_k$

$A_{k13} = -\sin\Theta_k$

$A_{k31} = \sin\Theta_k$

$A_{k33} = \cos\Theta_k$

3.1.2 Equations of Motion - The equations of motion are discussed in two parts. The equations of motion for the airplane are presented first. The second part discusses the landing gear equations which consist of the strut mass, strut secondary piston mass and the wheel equations.

3.1.2.1 Airplane Equations - The airplane rigid body and flexible body equations are developed in this section. The airplane main body is defined as the airplane less its landing gears. As such the airplane is represented by K+1 bodies: the aircraft main body is considered the 0^{th} body; a typical landing gear is considered the k^{th} body with K being the total number of gears. The landing gear struts are considered "rigid" in this development but allowed to move relative to the main body.

The dynamic motion of the main body is described using the normal mode method. In this method the main body motion is approximated by the combination of a limited number of vibratory modes plus the six rigid body modes. The main body's flexibility is represented by its free-free (unrestrained) vibratory modes. The rigid body modes were assumed to be the three translational displacements defining the position of the airplane's center of mass and three angular displacements defined in the body coordinate system.

In developing the airplane equations of motion, expressions defining the motion of an arbitrary point located on the landing gear and/or main body were obtained. These were used to evaluate the kinetic and potential energy of the airplane. The equations of motion were obtained by applying the Lagrangian equations to these energy expressions.

Using Figure 3-2, the total displacement of a point i is defined as

$$\bar{\rho}_{ki} = \bar{R} + (\bar{R}_k)_o + \bar{r}_{ki} \tag{3-4}$$

$\bar{\rho}_{ki}$ = position vector of point i relative to the inertial coordinate system.

$\bar{R}$ = position vector of reference point on main or 0^{th} body relative to inertial coordinate system.

$(\bar{R}_k)_o$ = position vector of k^{th} body reference point relative to the body coordinate system.

$\bar{r}_{ki}$ = position vector of point i relative to the strut or k^{th} body coordinate system.

k = Subscript defining a specific body. The airplane minus its gears is the 0^{th} body (k = 0). A typical landing gear is the k^{th} body (k = 1, 2, 3...K).

Note that for k = 0, the point i is on the main or 0^{th} body and $(\bar{R}_o)_o$ is identically zero. This gives

$$\bar{\rho}_{oi} = \bar{R} + \bar{r}_{oi} \tag{3-5}$$

$\bar{r}_{oi}$ = position vector of point i relative to the 0^{th} body coordinate system.

Differentiating the displacement vector given by equation (3-4) with respect to time to obtain the velocity required in the kinetic energy expression results in

$$\dot{\bar{\rho}}_{ki} = \dot{\bar{R}} + (\dot{\bar{R}}_k)_o + \bar{\omega}_o \times (\bar{R}_k)_o + \dot{\bar{r}}_{ki} + \bar{\omega}_k \times \bar{r}_{ki} \tag{3-6}$$

where $\dot{\bar{R}}$ = velocity vector of reference point on 0^{th} body in the inertial coordinate system

$(\dot{\bar{R}}_k)_o$ = velocity vector of k^{th} body reference point relative to 0^{th} body coordinate system

$\bar{\omega}_o$ = angular velocity of 0^{th} body in body coordinate system

$\dot{\bar{r}}_{ki}$ = velocity vector of point i relative to the strut coordinate system

$\bar{\omega}_k$ = angular velocity of the k^{th} body relative to the strut coordinate system

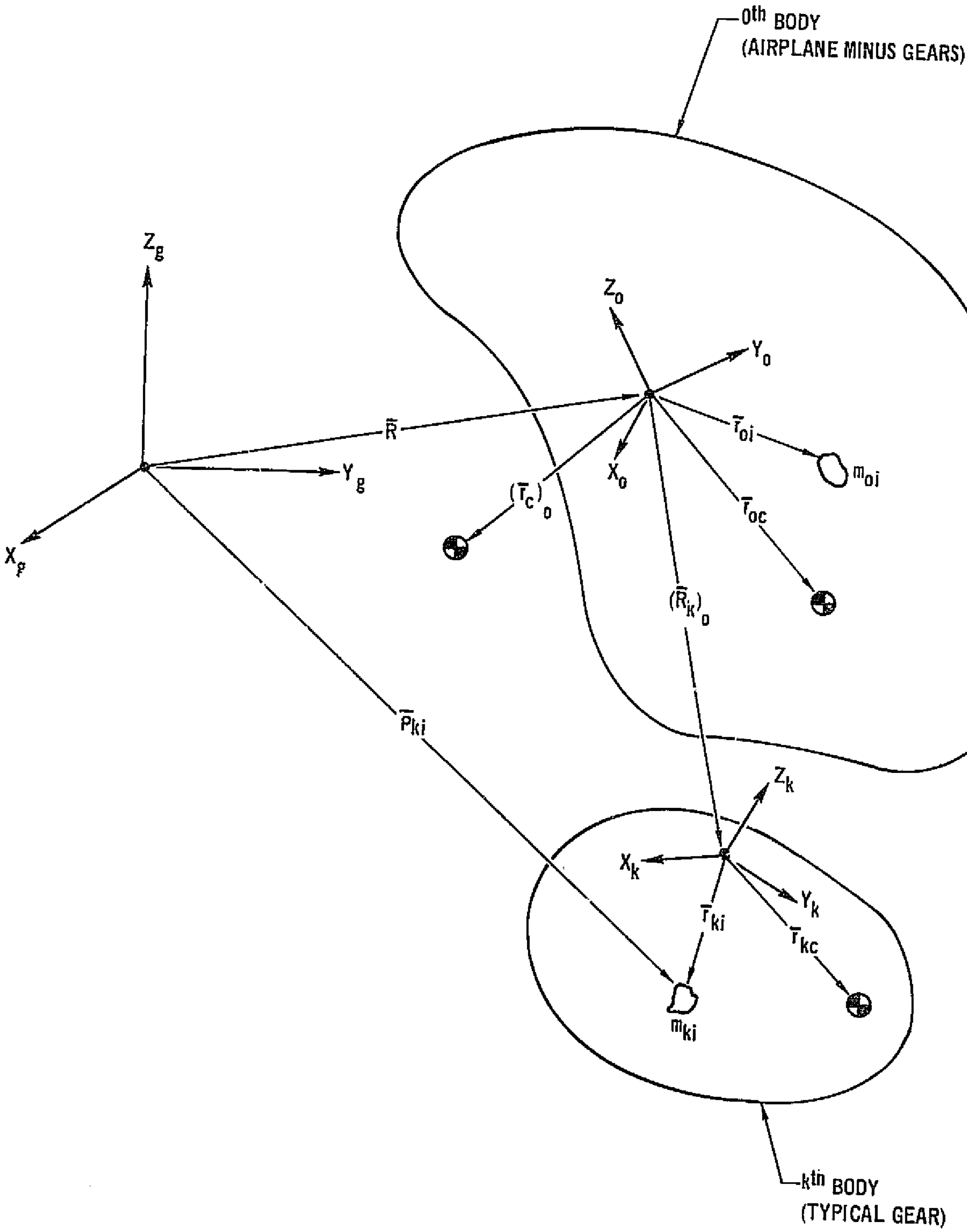

FIGURE 3–2 POSITION VECTORS

By locating the strut coordinate system reference point on the 0^{th} body at the the strut attachment point, the angular velocities of the body and strut coordinate systems are the same. Therefore

$$\overline{\omega}_o = \overline{\omega}_k = \overline{\omega} \tag{3-7}$$

and the velocity vector may be written

$$\dot{\overline{\rho}}_{ki} = \dot{\overline{R}} + (\dot{\overline{R}}_k)_o + \dot{\overline{r}}_{ki} + \overline{\omega} \times [(\overline{R}_k)_o + \overline{r}_{ki}] \tag{3-8}$$

It is assumed that the position vectors $(\overline{R}_k)_o$ and $\overline{r}_{ki}$ used to locate point i in equation (3-8) can be separated into terms which vary with time and terms which remain constant with time. Thus, these vectors may be written

$$\begin{aligned} (\overline{R}_k)_o &= \overline{R}_{ks} + \overline{R}_{ke}(t) \\ \overline{r}_{ki} &= \overline{r}_{kis} + \overline{r}_{kie}(t) \end{aligned} \tag{3-9}$$

where $\overline{R}_{ks}$ = undeformed position of k^{th} body reference point in the body coordinate system

$\overline{R}_{ke}(t)$ = deformed position of k^{th} body reference point in the body coordinate system measured from the undeformed position of that point

$\overline{r}_{kis}$ = undeformed position of point i in the strut coordinate system.

$\overline{r}_{kie}(t)$ = deformed position of point i in the strut coordinate system measured from the undeformed position of that point

These position vectors are shown in Figure 3-3.

Since it is assumed that the elastic deformation of the airplane main body can be represented by the superposition of a limited number of vibratory modes, the terms of $(\overline{R}_k)_o$ and $\overline{r}_{ki}$ that vary with time may be written as

$$\overline{R}_{ke}(t) = \sum_{n=1}^{N} \overline{\phi}_n^{k} q_n(t)$$

and for k=0 (3-10)

$$\overline{r}_{oie}(t) = \sum_{n=1}^{N} \overline{\phi}_n^{i} q_n(t)$$

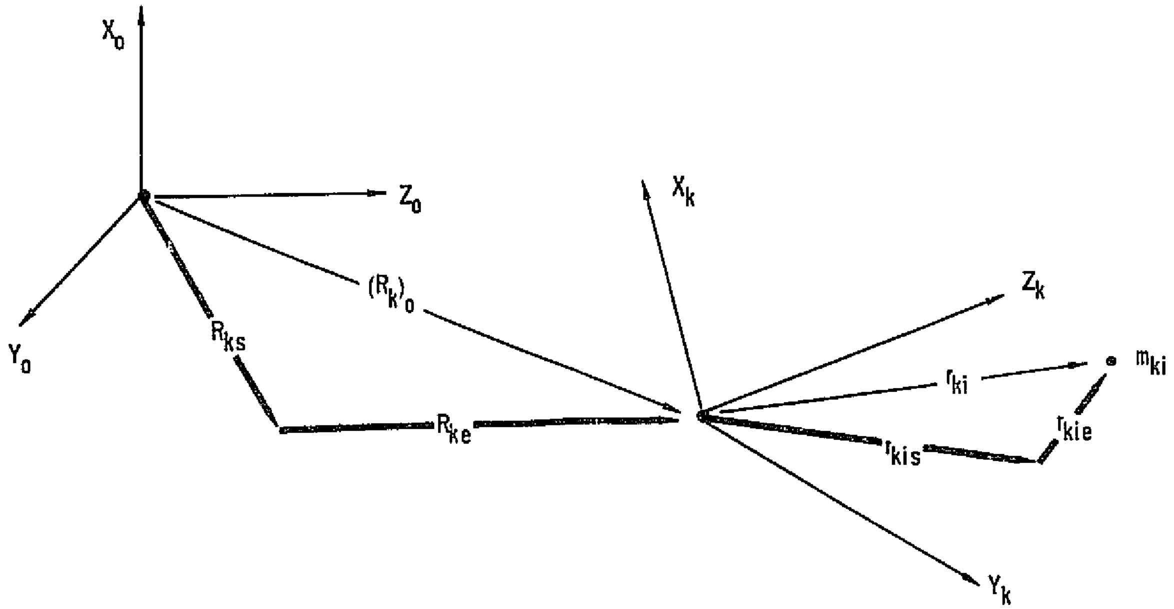

FIGURE 3–3 POSITION OF POINT i RELATIVE TO BODY COORDINATE SYSTEM

where N = number of vibratory modes included

$\bar{\phi}_n^{i}$, $\bar{\phi}_n^{k}$ = magnitude of n^{th} elastic mode at points i and k respectively. (k used to superscript refers to attachment point of k^{th} body, $k = 1, 2, 3 \ldots K$)

q_n = generalized coordinate associated with the n^{th} mode. These are a function of time.

Using equations 3-8, 3-9 and 3-10, the velocity of point i may be written as follows:

For point i on the k^{th} landing gear

$$\dot{\bar{\rho}}_{ki} = \dot{\bar{R}} + \sum_{n=1}^{N} \bar{\phi}_n^{k} \dot{q}_n + \dot{\bar{r}}_{kie} + \bar{\omega} \times [\bar{R}_{ks} + \sum_{n=1}^{N} \bar{\phi}_n^{k} q_n + \bar{r}_{kis} + \bar{r}_{kie}] \qquad (3\text{-}11)$$

For point i on the main or 0^{th} body

$$\dot{\bar{\rho}}_{oi} = \dot{\bar{R}} + \sum_{n=1}^{N} \bar{\phi}_n^{i} \dot{q}_n + \bar{\omega} \times [\bar{r}_{ois} + \sum_{n=1}^{N} \bar{\phi}_n^{k} q_n] \qquad (3\text{-}12)$$

The kinetic energy of the K+1 bodies, T, is obtained by summing the

kinetic energy of all points i in the system having a mass m_{ki}

$$T = \frac{1}{2} \sum_{k=0}^{K} \sum_{i=1}^{I} m_{ki} \dot{\bar{\rho}}_{ki} \cdot \dot{\bar{\rho}}_{ki} \tag{3-13}$$

where K is the total number of landing gears and I is the total number of mass points.

The 0^{th} or elastic body kinetic energy may be separated from the strut kinetic energy to give

$$T = \frac{1}{2} \sum_{i=1}^{I} m_{oi} \dot{\bar{\rho}}_{oi} \cdot \dot{\bar{\rho}}_{oi} + \frac{1}{2} \sum_{k=1}^{K} \sum_{i=1}^{I} m_{ki} \dot{\bar{\rho}}_{ki} \cdot \dot{\bar{\rho}}_{ki} \tag{3-14}$$

Since the struts are considered rigid,

$$\sum_{i=1}^{I} m_{ki} \dot{\bar{\rho}}_{ki} = m_k \dot{\bar{\rho}}_{kc} \tag{3-15}$$

and the kinetic energy may be written

$$T = \frac{1}{2} \sum_{i=1}^{I} m_{oi} \dot{\bar{\rho}}_{oi} \cdot \dot{\bar{\rho}}_{oi} + \frac{1}{2} \sum_{k=1}^{K} m_k \dot{\bar{\rho}}_{kc} \cdot \dot{\bar{\rho}}_{kc} \; . \tag{3-16}$$

In this expression m_k is the mass of the k^{th} strut and $\dot{\bar{\rho}}_{kc}$, the velocity of the k^{th} strut mass center is given by

$$\dot{\bar{\rho}}_{kc} = \dot{\bar{R}} + \sum_{n=1}^{N} \bar{\phi}_n^{k} \dot{q}_n + \dot{\bar{r}}_{kce} + \bar{\omega} \times [\bar{R}_{ks} + \sum_{n=1}^{N} \bar{\phi}_n^{k} q_n + \bar{r}_{kcs} + \bar{r}_{kce}] \tag{3-17}$$

in which the subscript c refers to the mass center of the k^{th} strut. Note that $\bar{r}_{kcs} + \bar{r}_{kce} = \bar{r}_{kc}$, the position vector of the k^{th} strut mass center relative to the strut coordinate system (See Figure 3-2).

The components of the vectors $\dot{\bar{\rho}}_{oi}$ and $\dot{\bar{\rho}}_{kc}$ in the kinetic energy expression (3-16) were used in applying the Lagrangian equations. The components of these vectors are defined below using the unit normal vectors $(\bar{i}_x, \bar{i}_y, \bar{i}_z)$ for the coordinate system in which they are defined.

$$
\begin{aligned}
\overline{R} &= X_g\,\overline{i}_{xg} + Y_g\,\overline{i}_{yg} + Z_g\,\overline{i}_{zg} \\
\overline{\phi}^{\,i}_n &= \phi^i_{xn}\,\overline{i}_{xo} + \phi^i_{yn}\,\overline{i}_{yo} + \phi^i_{zn}\,\overline{i}_{zo} \\
\overline{\omega} &= \omega_x\,\overline{i}_{xo} + \omega_y\,\overline{i}_{yo} + \omega_z\,\overline{i}_{zo} \\
\overline{R}_{ks} &= R_{ksx}\,\overline{i}_{xo} + R_{ksy}\,\overline{i}_{yo} + R_{ksz}\,\overline{i}_{zo} \\
\overline{r}_{kcs} &= r_{kcsx}\,\overline{i}_{xk} + r_{kcsy}\,\overline{i}_{yk} + r_{kcsz}\,\overline{i}_{zk} \\
\overline{r}_{kce} &= r_{kcex}\,\overline{i}_{xk} + r_{kcey}\,\overline{i}_{yk} + r_{kcez}\,\overline{i}_{zk} \\
\overline{r}_{ois} &= r_{oisx}\,\overline{i}_{xo} + r_{oisy}\,\overline{i}_{yo} + r_{oisz}\,\overline{i}_{zk}
\end{aligned}
\tag{3-18}
$$

The position vector

$$\overline{r}_{kc} = \overline{r}_{kcs} + \overline{r}_{kce} \tag{3-19}$$

defines the position of the k^{th} strut center of mass relative to the strut coordinate system in general terms. To incorporate the strut configuration modeled in TOLA, this vector was modified to reflect the actual strut displacements. Using Figure 3-4, which was adapted from Reference (1), the displacement, $\overline{r}_{kc}$, of the k^{th} moving strut mass is given by

$$\overline{r}_{kc} = (r_{Fk} - S_{kc} - S_k)\,\overline{i}_{zk} \tag{3-20}$$

where r_{Fk} = fully extended position of axle

S_{kc} = distance between strut axle and strut mass center

S_k = main strut displacement

Equation (3-20) is equation (26) of Reference 1. The quantities r_{Fk} and S_{kc} are reference lengths or distances and S_k is the time varying displacement restricted to move in the $\overline{i}_{zk}$ direction. Therefore the components in equation (3-19) become

$$
\begin{aligned}
\overline{r}_{kcs} &= (r_{Fk} - S_{kc})\,\overline{i}_{zk} \\
\overline{r}_{kce} &= -\,S_k\,\overline{i}_{zk}
\end{aligned}
\tag{3-21}
$$

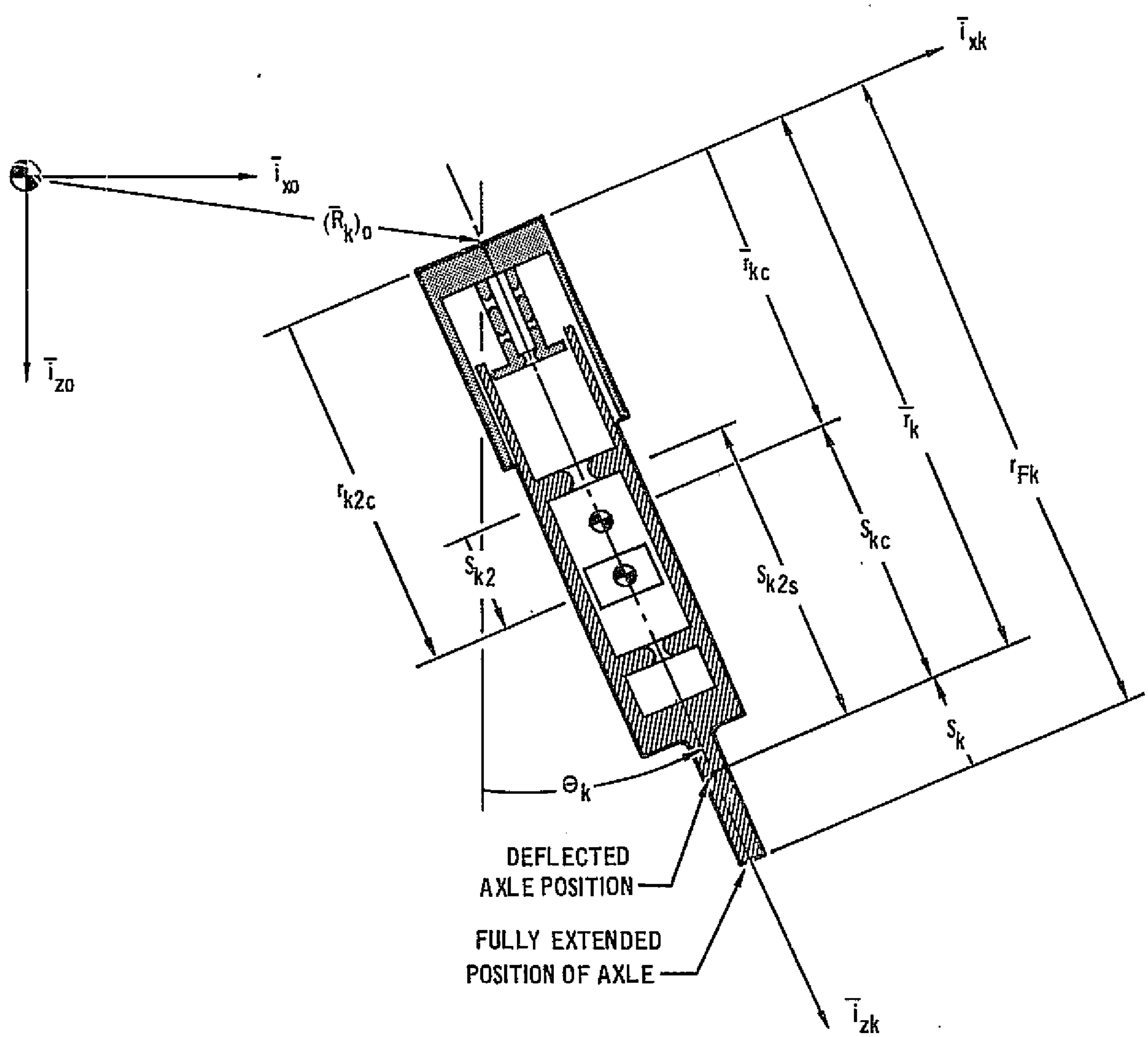

FIGURE 3–4 LANDING GEAR STRUT DISPLACEMENTS

The potential energy, U, due to the strain energy of the main or 0^{th} body is

$$U = \frac{1}{2} \sum_{n=1}^{N} \omega_n^{\,2} \, m_n \, q_n^2 \tag{3-22}$$

where ω_n = the natural frequency of the n^{th} free-free mode

m_n = generalized mass of n^{th} elastic mode

The airplane's equations of motion were obtained by using the Lagrangian equations and the energy expressions of (3-16) and (3-22). The Lagrangian equations may be written

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{q}_p}\right) - \frac{\partial T}{\partial q_p} + \frac{\partial U}{\partial q_p} = Q_p \tag{3-23}$$

where q_p, $\dot{q}_p$ = p^{th} generalized coordinate and generalized velocity respectively

Q_p = generalized force or moment in p^{th} mode

The resulting rigid body translational, rigid body rotational, and the flexible body equations of motion are given in Equations (3-24), (3-25) and (3-26) respectively. Insofar as practical, TOLA nomenclature (Reference 1) has been used. Therefore, the rigid body equations reflecting the effects of the 0^{th} body flexibility can be readily compared to the existing TOLA rigid body equations given in Reference (1) as Equations (157) and (158). The flexible body equations are coupled together and to the rigid body equations by the strut masses m_k. This results from the manner in which the airplane was idealized as a system of K+1 bodies. The struts (the k bodies) were considered "rigid" but allowed to move with respect to the main body or airframe. The airframe (0^{th} body) was considered flexible with its elastic effects represented by a limited number of free-free vibratory modes.

RIGID BODY TRANSLATIONAL EQUATIONS

$$\bar{F}_T = M_T \ddot{\bar{R}} - \sum_{k=1}^{K} m_k \ddot{S}_k [A_{k31} \bar{i}_{xo} + A_{k33} \bar{i}_{zo}] + \sum_{n=1}^{N} \sum_{k=1}^{K} m_k \ddot{q}_n [\phi^k_{xn} \bar{i}_{xo}$$

$$+ \phi^k_{yn} \bar{i}_{yo} + \phi^k_{zn} \bar{i}_{zo}] \tag{3-24}$$

RIGID BODY ROTATIONAL EQUATIONS

$$\bar{M}_o = \bar{\bar{I}} \cdot \dot{\bar{\omega}} + \bar{\omega} \times [\bar{\bar{I}} \cdot \bar{\omega}] + \sum_{k=1}^{K} m_k \ddot{S}_k [- A_{k11} R_{ksy} \bar{i}_{xo} + (A_{k13} R_{ksz}$$

$$+ A_{k11} R_{ksx}) \bar{i}_{yo} - A_{k13} R_{ksy} \bar{i}_{zo}]$$

$$+ \sum_{n=1}^{N} \sum_{k=1}^{K} m_k \ddot{q}_n \Big\{ [R_{ksy} \phi^k_{zn} - (R_{ksz} + A_{k11} (r_{Fk} - S_{kc})) \phi^k_{yn}] \bar{i}_{xo} \tag{3-25}$$

$$+ [(R_{ksz} + A_{k11} (r_{Fk} - S_{kc})) \phi^k_{xn} - (R_{ksx} - A_{k13} (r_{Fk} - S_{kc})) \phi^k_{zn}] \bar{i}_{yo}$$

$$+ [(R_{ksx} - A_{k13} (r_{Fk} - S_{kc})) \phi^k_{yn} - R_{ksy} \phi^k_{xn}] \bar{i}_{zo} \Big\}$$

$\bar{F}_T$ = total applied force acting on K+1 bodies

M_T = total mass of K+1 bodies

$\bar{M}_o$ = total moment of all applied forces on K+1 bodies about 0^{th} body center of mass

$\bar{\bar{I}}$ = inertia tensor for the K+1 bodies about 0^{th} body center of mass

FLEXIBLE AIRFRAME EQUATIONS OF MOTION

FOR $S = 1, 2, 3, \ldots N$

$$m_s \ddot{q}_s + \omega_s^{\,2} m_s q_s + \sum_{n=1}^{N} \sum_{k=1}^{K} m_k [\phi^k_{xs} \phi^k_{xn} + \phi^k_{ys} \phi^k_{yn} + \phi^k_{zs} \phi_{zn}] \ddot{q}_n$$

$$+ \sum_{k=1}^{K} m_k [(\ddot{X} - A_{k31} \ddot{S}_k) \phi^k_{xs} + \ddot{Y} \phi^k_{ys} + (\ddot{Z} - A_{k33} \ddot{S}_k) \phi^k_{zs}]$$

$$+ \dot{\omega}_x \sum_{k=1}^{K} m_k [R_{ksy} \phi^k_{zs} - (R_{ksz} + A_{k11} (r_{Fk} - S_{kc})) \phi^k_{ys}] \tag{3-26}$$

$$+ \dot{\omega}_y \sum_{k=1}^{K} m_k [(R_{ksz} + A_{k11} (r_{Fk} - S_{kc})) \phi^k_{xs} - (R_{ksx} - A_{k13} (r_{Fk} - S_{kc})) \phi^k_{zs}]$$

$$+ \dot{\omega}_z \sum_{k=1}^{K} m_k [(R_{ksx} - A_{k13} (r_{Fk} - S_{kc})) \phi^k_{ys} - R_{ksy} \phi^k_{xs}] = Q_s$$

$Q_s = Q_s^T + Q_s^{DC} + Q_s^A$ = Generalized forces associated with s th mode due to engine thrust, drag chute deployment and aerodynamic pressure respectively

Symbols are defined on the following page

FLEXIBLE AIRFRAME EQUATIONS OF MOTION

m_s, q_s, ω_s = Generalized mass, generalized coordinate and natural frequency respectively associated with the s th elastic free-free mode

$$Q_s^T = \phi_{xs}^{T_1} T_{x1} + \phi_{xs}^{T_2} T_{x2} + \phi_{xs}^{T_3} T_{x3} + \phi_{xs}^{T_4} T_{x4}$$

T_{x1} through T_{x4} = Engine thrust forces

$\phi_{xs}^{T_1}$ through $\phi_{xs}^{T_4}$ = Magnitude of s th mode shape at point force application

$$Q_s^{DC} = \phi_{xs}^{DC} F_{cx} + \phi_{ys}^{DC} F_{cy} + \phi_{zs}^{DC} F_{cz}$$

F_{cx}, F_{cy}, F_{cz} = Forces due to deployment of drag chute

$\phi_{xs}^{DC}, \phi_{ys}^{DC}, \phi_{zs}^{DC}$ = Magnitude of s th mode shape at point of force application

$$Q_s^A = -B_s^1 \phi_{xs}^A a + B_s^2 \phi_{ys}^A y - B_s^3 \phi_{zs}^A n_f + B_s^4 \theta_{xs}^A l + B_s^5 \theta_{ys}^A m + B_s^6 \theta_{zs}^A n$$

a, y, n_f = Aerodynamic forces; l, m, n = aerodynamic moments

$\phi_{xs}^A, \phi_{ys}^A, \phi_{zs}^A$ = Magnitude of s th mode shape at point of force application

$\theta_{xs}^A, \theta_{ys}^A, \theta_{zs}^A$ = Slope of s th mode shape at point of moment application

B_s^1 through B_s^6 = Participation factors for s th mode

Certain simplifying assumptions were made in the equations of motion. These assumptions were consistent with those made in the existing TOLA formulation. In the rigid body equations, the Coriolis acceleration terms for the landing gear struts were neglected mainly because the rotational velocities of the aircraft are small at landing relative to strut acceleration terms retained. Also, in the rigid body rotational equations, terms involving the variation of the inertia or inertia derivative tensors resulting from changing position vectors of the strut masses are small. The changes in the gear positions are very small compared to the overall airplane dimensions, therefore the variation of the inertia terms due to gear position changes are small and were neglected. The flexible airframe equations of motion were also simplified by neglecting terms analogous to those neglected in the rigid body equations. Coriolis and centripetal type accelerations of the strut masses were considered small, again mainly because the rotational velocities of the aircraft are small relative to the strut acceleration terms retained. Rigid body "tangential" type acceleration terms that vary with changing position vectors were neglected; however, all others were retained.

The terms in the rigid body equations, (3-24) and (3-25), resulting from the addition of flexibility were programmed and added to the rigid body equations already coded in TOLA. The flexible airframe equations of motion (3-26) in their entirety were programmed and incorporated in TOLA. Modifications in the strut equations of motion required to reflect the elasticity of the airframe are discussed in the following section.

3.1.2.2 Landing Gear Equations - These equations consist of the strut mass, strut secondary piston, and wheel equations of motion. Since the basic landing gear idealizations are identical to those used in the existing TOLA computer program, their equations of motion will not be completely rederived. However, they will be discussed in sufficient detail so as to clarify the changes made.

The equation of the k^{th} strut mass for a rigid airframe from Reference (1), (Equation 37) is

$$\ddot{S}_k = \{\ddot{\overline{R}} + \dot{\overline{\omega}} \times (\overline{R}_k)_o + \overline{\omega} \times [\overline{\omega} \times (\overline{R}_k)_o]\} \cdot \overline{i}_{zk} - \frac{1}{m_k} \sum F_{kz} \qquad (3\text{-}27)$$

where F_{kz} = forces applied to k^{th} strut in $\overline{i}_{zk}$ direction

The strut mass, m_k, is defined as the landing gear mass which may move relative to the airframe (0^{th} body). S_k is defined in Figure 3-4 and

Equation (3-20). Neglected and not shown in Equation (3-27) are the quantities $2\overline{\omega} \times \dot{\overline{r}}_{kc}$, $\dot{\overline{\omega}} \times \overline{r}_{kc}$ and $\overline{\omega} \times [\overline{\omega} \times \overline{r}_{kc}]$. These quantities were neglected since $\overline{\omega}$ and $\dot{\omega}$ are small at landing and $(\overline{R}_k)_o >> \overline{r}_{kc}$.

With airframe flexibility, the equation of motion for the k^{th} strut mass becomes

$$\ddot{S}_k = \{\ddot{\overline{R}} + \ddot{\overline{R}}_{ke} + \dot{\overline{\omega}} \times \overline{R}_{ks} + \overline{\omega} \times [\overline{\omega} \times \overline{R}_{ks}]\} \cdot \overline{i}_{zk} - \frac{1}{m_k} \sum F_{zk} \qquad (3\text{-}28)$$

In addition to the terms neglected in Equation (3-27), the quantities $2\overline{\omega} \times \dot{\overline{R}}_{ke}$, $\dot{\overline{\omega}} \times \overline{R}_{ke}$, and $\overline{\omega} \times [\overline{\omega} \times \overline{R}_{ke}]$ were neglected in Equation (3-28) since $\overline{\omega}$ is small at landing and $\overline{R}_{ks} >> \overline{R}_{ke}$. Thus, the modification in the strut equation of motion to reflect airframe flexibility is

$$\ddot{\overline{R}}_{ke} \cdot \overline{i}_{zk} = A_{k31} \sum_{n=1}^{N} \phi^k_{xn} \ddot{q}_n + A_{k33} \sum_{n=1}^{N} \phi^k_{zn} \ddot{q}_n \qquad (3\text{-}29)$$

Equation (3-29) was programmed and incorporated in the strut equations solved in TOLA's flexible body option.

The forces, F_{zk}, acting on the k^{th} strut in Equation (3-28) are completely defined in Reference (1). Some of these forces are functions of S_{k2} and $\dot{S}_{k2}$, the displacement and velocity respectively, of the strut secondary piston mass. Figure 2-1 shows the secondary piston mass and Figure 3-4 shows S_{k2}. The equation of motion for the k^{th} strut secondary piston mass for a rigid airframe from Reference (1), (Equation 56) is

$$\ddot{S}_{k2} = \frac{1}{m_{k2}} \sum F_{k2z} - \{\ddot{\overline{R}} + \dot{\overline{\omega}} \times (\overline{R}_k)_o + \overline{\omega} \times [\overline{\omega} \times (\overline{R}_k)_o]\} \cdot \overline{i}_{zk} + \ddot{S}_k \qquad (3\text{-}30)$$

where m_{k2} = mass of k^{th} strut secondary piston mass

F_{k2z} = forces applied to k^{th} strut secondary piston mass

$\ddot{S}_k$ = Defined in Equation (3-27)

For the flexible body option, the k^{th} strut secondary piston mass equation is

$$\ddot{S}_{k2} = \frac{1}{m_{k2}} \sum F_{k2z} - \{\ddot{\overline{R}} + \ddot{\overline{R}}_{ke} + \dot{\overline{\omega}} \times \overline{R}_{ks} + \overline{\omega} \times [\overline{\omega} \times \overline{R}_{ks}]\} \cdot \overline{i}_{zk} + \ddot{S}_k \qquad (3\text{-}31)$$

in which $\ddot{S}_k$ is defined by Equation (3-28). The simplifying assumptions made to obtain Equations (3-30) and (3-31) are identical to those made in arriving

at Equations (3-27) and (3-28) respectively. Equation (3-29) also defines the changes made to the k^{th} strut secondary piston mass equation of motion in TOLA to incorporate the flexible body option.

The final landing gear equation of motion to consider is the strut wheel rotational equation. Since the ground reaction forces are dependent on the tire-ground interface velocities, the rotational velocities of the wheels or tires are required. The rotational equation of motion for the k^{th} strut wheel is

$$\dot{\omega}_{Tk} = \left(M_{Ak} - M_{Bk} \frac{\omega_{Tk}}{|\omega_{Tk}|}\right) \cdot \left(\frac{1}{n_k \; I_k}\right) \tag{3-32}$$

ω_{Tk} = rotational rate of k^{th} strut wheel

M_{Ak} = moment of the ground reaction forces about k^{th} strut axle

M_{Bk} = moment of the applied braking forces about k^{th} strut axle

I_k = moment of inertia of k^{th} strut wheel about axle

n_k = number of tires on k^{th} strut

The above Equation (3-32) from Reference (1) (Equation 148) remains unchanged in form for the flexible body option. However, the moment M_{Ak} is dependent on the airframe elastic displacements and velocities.

In addition to M_{Ak}, the ground reaction forces and moments included in $\overline{F}_T$, $\overline{M}_o$ and F_{zk} of equations (3-24), (3-25), and (3-28) are functions of the airframe elastic displacements or velocities. Also, other quantities, such as the tire deflection, which is directly used in the TOLA program logic to determine whether or not the tire deflection has been exceeded, depend in part on the airframe elastic displacements. The changes in the TOLA equations made to reflect these effects are defined below.

The position vector of the k^{th} strut axle for a rigid airframe, from Equation (98) of Reference (1), is

$$(\overline{R}_k)_o + \overline{r}_k = R_{Axk} \; \overline{i}_{xg} + R_{Ayk} \; \overline{i}_{yg} + R_{Azk} \; \overline{i}_{zg} \tag{3-33}$$

where

$$\begin{Bmatrix} R_{Axk} \\ R_{Ayk} \\ R_{Azk} \end{Bmatrix} = \begin{bmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{bmatrix} \begin{bmatrix} [R_{kx} + A_{k31} (r_{Fk} - S_k)] \\ [R_{ky}] \\ [R_{kz} + A_{k33} (r_{Fk} - S_k)] \end{bmatrix}$$

This position vector is shown in Figure 3-4. Using the first of Equations (3-9) and (3-10), the position vector of the k^{th} strut axle for the flexible airframe option becomes

$$\begin{Bmatrix} R_{Axk} \\ R_{Ayk} \\ R_{Azk} \end{Bmatrix} = \begin{Bmatrix} R_{Axk} \\ R_{Ayk} \\ R_{Azk} \end{Bmatrix} + \begin{Bmatrix} \Delta R_{Axk} \\ \Delta R_{Ayk} \\ \Delta R_{Azk} \end{Bmatrix} \tag{3-34}$$

where

$$\begin{Bmatrix} \Delta R_{Axk} \\ \Delta R_{Ayk} \\ \Delta R_{Azk} \end{Bmatrix} = \begin{bmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{bmatrix} \begin{Bmatrix} \sum_{n=1}^{N} \phi_{xn}^{k} q_n \\ \sum_{n=1}^{N} \phi_{yn}^{k} q_n \\ \sum_{n=1}^{N} \phi_{zn}^{k} q_n \end{Bmatrix}$$

The velocity vector of the k^{th} strut axle was also modified. From Equation (139) of Reference (1), the velocity vector for the axle assuming a rigid airframe is

$$(\dot{\bar{R}}_k)_o + \dot{\bar{r}}_k = R_{Dxk} \bar{i}_{xo} + R_{Dyk} \bar{i}_{yo} + R_{Dzk} \bar{i}_{zo} \tag{3-35}$$

where

$$\begin{Bmatrix} R_{Dxk} \\ R_{Dyk} \\ R_{Dzk} \end{Bmatrix} = \begin{bmatrix} [-\dot{S}_k A_{k31} + \omega_y A_{k33} (r_{Fk} - S_k) + \omega_y R_{kz} - \omega_z R_{ky}] \\ [(r_{Fk} - S_k) (\omega_z A_{k31} - \omega_x A_{k33}) + \omega_z R_{kx} - \omega_x R_{kz}] \\ [-\dot{S}_k A_{k33} - \omega_y A_{k31} (r_{Fk} - S_k) + \omega_x R_{ky} - \omega_y R_{kx}] \end{bmatrix}.$$

Using the time derivatives of the first of Equations (3-9) and (3-10), the velocity vector of the k^{th} strut axle for the flexible airframe option is

$$\begin{Bmatrix} R_{Dxk} \\ R_{Dyk} \\ R_{Dzk} \end{Bmatrix} = \begin{Bmatrix} R_{Dxk} \\ R_{Dyk} \\ R_{Dzk} \end{Bmatrix} + \begin{Bmatrix} \Delta\ R_{Dxk} \\ \Delta\ R_{Dyk} \\ \Delta\ R_{Dzk} \end{Bmatrix} \tag{3-36}$$

where

$$\begin{Bmatrix} \Delta\ R_{Dxk} \\ \\ \Delta\ R_{Dyk} \\ \\ \Delta\ R_{Dzk} \end{Bmatrix} = \begin{Bmatrix} [\omega_y \sum_{n=1}^{N} \phi_{zn}^{k}\ q_n - \omega_z \sum_{n=1}^{N} \phi_{yn}^{k}\ q_n + \sum_{n=1}^{N} \phi_{xn}^{k}\ \dot{q}_n] \\ [\omega_z \sum_{n=1}^{N} \phi_{xn}^{k}\ q_n - \omega_x \sum_{n=1}^{N} \phi_{zn}^{k}\ q_n + \sum_{n=1}^{N} \phi_{yn}^{k}\ \dot{q}_n] \\ [\omega_x \sum_{n=1}^{N} \phi_{yn}^{k}\ q_n - \omega_y \sum_{n=1}^{N} \phi_{xn}^{k}\ q_n + \sum_{n=1}^{N} \phi_{zn}^{k}\ \dot{q}_n] \end{Bmatrix}$$

This completes the discussion of the analytical methods used to modify the TOLA computer program to incorporate the flexible body option.

3.2 Program Description - The changes and additions made to the TOLA computer program are discussed in general in this section. The structure of the flexible body option and how it interfaces with the existing TOLA program are described using a flow diagram. All programming is in CDC FORTRAN 2.3 language for machine computation on CDC 6000 series computers.

3.2.1 Option Flow Diagram - A flow diagram showing the general operation of the flexible body option is shown in Figure 3-5. The three OVERLAY segments are shown in addition to the various subroutines which directly interface with the flexible body option subroutine, FLEX1. The diagram is not intended to be a comprehensive programming chart, but shows the general flow of the option logic and indicates the order of operations within FLEX1. A complete listing of the TOLA computer program with flexible body option is given in Appendix A.

The basic structure of TOLA has been retained. It is still made up of three OVERLAY segments. OVERLAY (TOLA, 0, 0) consists of the executive subprogram TOLA. Through its call to subroutine EXE, it calls the other two overlays and controls the execution of the complete program. TOLAN1 is the executive subprogram in OVERLAY (TOLA, 1, 0). It reads the input data and checks to determine if the proper amount of input data has been supplied. TOLAN2 is the executive subprogram in OVERLAY (TOLA, 2, 0). It provides the autopilot and problem phase functions.

The flexible body option is contained in subroutine FLEX1. The operations performed in FLEX1 are indicated in Figure 3-5. FLEX1 is structured similar to subroutines OPT1 and LGEAR1. This allows efficient use of the existing read, write, integration and update routines.

3.3 Program Operation - An understanding of program development in itself will not result in smooth program operation. Successful operation of the TOLA computer program with the flexible body option depends on proper input of all required data. Much of these data are associated with the existing rigid body version of TOLA. It is not the purpose of this document to define these data, for this is done in Reference 3. The sections that follow will describe the general input data format, define all possible data associated with the flexible body option and the manner in which it is to be input, and discuss the resulting output.

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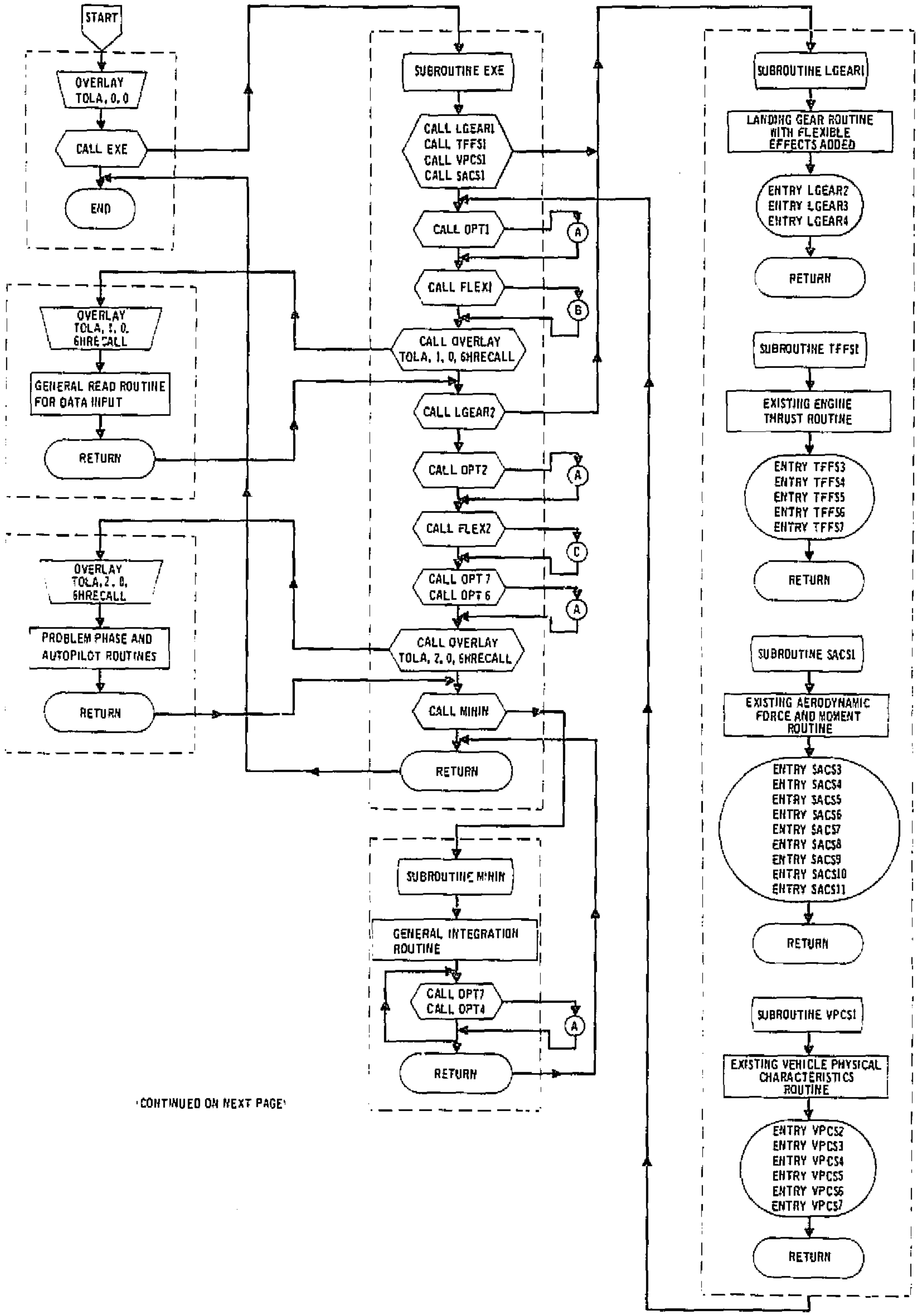

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FIGURE 3-5 FLOW DIAGRAM FOR TOLA COMPUTER PORGRAM FLEXIBLE BODY OPTION

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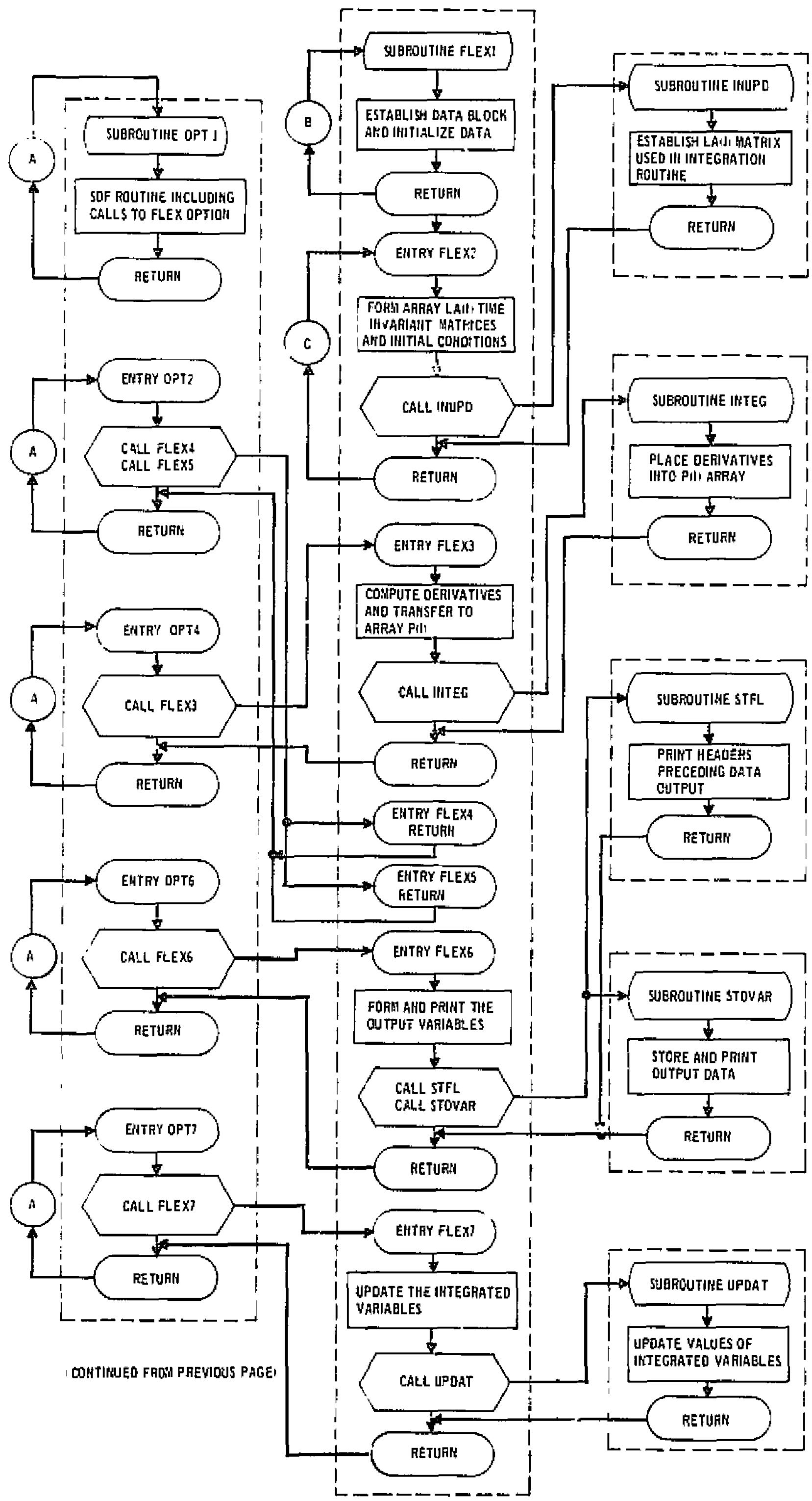

FIGURE 3–5 FLOW DIAGRAM FOR TOLA COMPUTER PROGRAM FLEXIBLE BODY OPTION (Continued)

3.3.1 <u>General Input Data Format</u> - The input data associated with the flexible body option are read into the program by the existing input routine (READ). As a result, it must follow the same general format as the rigid body data. The input must follow the following format:

Card Columns	1-6	7	8-10	11	12-66	67-72	73-80
Field Number	I	II	III	IV	V	VI	VII

<u>Field number I</u> contains the alphanumeric variable name of the data contained in Field V. Example:

FORTRAN STATEMENT

```
INDFLX     1
```

The program will assign a value of "1" to the variable INDFLX.

<u>Field number II</u> is not used.

<u>Field number III</u> is used to define the type of data in Field V by means of the words DEC, BCD, INT, TRA or a blank. <u>DEC</u> and blank are equivalent and denote that data which follow are in decimal form. The work <u>ØCT</u> specifies that the data in Field V are to be interpreted as octal numbers. The word <u>BCD</u> specifies that N binary coded, six character words (N punched in column 12) are to be loaded. These decimal words begin in column 13. The largest number of six character words that can be loaded from one card is nine. The user should make sure that BCD data does not get punched into Field VI, or an input error will result. When the word <u>INT</u> is used, it is assumed that all numbers in Field V will be loaded as integers. If only one integer is punched per card, the INT may be omitted. The word <u>TRA</u> denotes to the read routine that all data have been input and to return control to the calling program.

Example:

FORTRAN STATEMENT

```
REM    BCD 4FLEXIBLE BODY OPTION
FREQ   DEC 2.0,5.67,200.0
       TRA
```

On the first card, the 4 in column 12 indicates that four words follow; each word is six characters long. This is a remarks card which helps identify the data that follows. The second card defines a variable array FREQ(I) whose elements are 2.0, 5.67 and 200.0 respectively. The third card denotes the end of the data.

Field number IV is not used.

Field number V contains the data input to the program. DEC, ØCT and INT numbers must be left adjusted; that is, data must always start in column 12. All numbers must be separated by a comma and the field terminates with the first blank. BCD information begins in column 13. Because the field ends with a blank, the user may add any comments in the remainder of the field.

Field number VI specifies the initial array location or subscript of the data in Field V. If this field is blank, an initial subscript of 1 is implied. The subscript may appear anywhere in the field. Example:

```
COMM STATEMENT NUMBER CONT   FORTRAN STATEMENT
SXMOD      0.075,0.893,0.942
SXMOD      1.0,0.331                                              4
```

In the example, SXMOD is an array containing five elements. The first element is 0.075 while the fourth element is 1.0 as denoted by the 4 in column 67.

Field number VII is not used as far as the input routine is concerned.

3.3.2 Input Data for the Flexible Body Option - The revised TOLA computer program can be run considering either a rigid or a flexible airframe. In either case, all of the data defined in Reference 3 for a particular case must be input. The additional data required by the flexible body option of the TOLA computer program are defined in Figure 3-6 and discussed below.

To use TOLA when the airframe is considered rigid, the indicator INDFLX must be equal to zero. No other additional input is required.

To use TOLA when the airframe is considered flexible, the indicator INDFLX must be set equal to one and additional data describing the airframe elasticity are required. The number of free-free normal modes, NMODE, representing the airframe flexibility must be specified. A maximum of twenty modes

INPUT INDICATOR/ VARIABLE	COORDINATE SYSTEM(1)	INDICATOR OR VARIABLE DEFINITION
INDFLX		INDICATOR DEFINING OPTION INDFLX = 0 - RIGID AIRFRAME INDFLX = 1 - FLEXIBLE AIRFRAME
NMODE		INDICATES NUMBER OF MODES INPUT (20 MAXIMUM)
GMASS1(I)		GENERALIZED MASS OF I TH ELASTIC MODE
GFREQ(I)		FREQUENCY OF I TH MODE (RADIANS/SEC)
SXMOD(I)	BCS	X MODE SHAPE FOR STRUT ATTACHMENT POINTS IN I TH MODE
SYMOD(I)	BCS	Y MODE SHAPE FOR STRUT ATTACHMENT POINTS IN I TH MODE
SZMOD(I)	BCS	Z MODE SHAPE FOR STRUT ATTACHMENT POINTS IN I TH MODE
TXMOD(I)	BCS	X MODE SHAPE FOR ENGINE THRUST APPLICATION ATTACHMENT POINTS IN I TH MODE
ARMODE(I)	BCS	X,Y,Z,θ_x,θ_y,θ_z COMPONENTS OF MODE SHAPE FOR AERODYNAMIC FORCE AND MOMENT REFERENCE LOCATION IN I TH MODE
PF(I)		PARTICIPATION FACTORS OF GENERALIZED AERODYNAMIC FORCES AND MOMENTS IN I TH MODE
SKC(K)	SCS	DISTANCE BETWEEN K TH STRUT AXLE AND STRUT CENTER OF MASS
DCMODE(1)	BCS	X,Y,Z COMPONENTS OF MODE SHAPE FOR DRAG CHUTE ATTACHMENT POINT IN I TH MODE
NPTS		NUMBER OF POINTS ON THE AIRFRAME AT WHICH OUTPUT IS REQUESTED (20 MAXIMUM)
ROIS(J)	BCS	ROISX, ROISY, ROISZ COMPONENTS OF POSITION VECTOR FOR J TH POINT ON FLEXIBLE AIRFRAME AT WHICH OUTPUT IS REQUESTED
OUTMOD(I)	BCS	X,Y,Z COMPONENTS OF I TH MODE SHAPE FOR POINTS ON FLEXIBLE AIRFRAME AT WHICH OUTPUT IS REQUESTED.
IFLX(I)		INDICATES THE POINTS WHOSE DATA WILL BE STORED ON TAPE

(1) NOTE: BCS = BODY COORDINATE SYSTEM SCS = STRUT COORDINATE SYSTEM

FIGURE 3-6 INPUT DATA FOR TOLA FLEXIBLE BODY OPTION

can be used. The natural frequency, GFREQ(I), and generalized mass, GMASS1(I), for each mode must be input. The mode shape magnitudes, SXMOD(I), SYMOD(Y), SZMOD(Z), for each mode at the strut attachment locations should be input. While the program will run without these input data, it will use a value of zero for the mode shape magnitudes. Similarly, the mode shape data at the point of application of the engine thrust, TXMOD(I), and aerodynamic forces and moments, ARMODE(I), should be input for solution of any practical takeoff/landing problem.

The aerodynamic loads are treated as concentrated loads in TOLA in the form of total aerodynamic forces and moments acting at a selected reference point on the airframe. To obtain realistic flexible body response, weighting effects or participation factors, PF(I), of the aerodynamic loads on the response of each normal mode are required. If aerodynamic effects on the flexible airframe response are desired, the user must input the proper values for the PF(I) array. If the PF(I) are not input, the default values for this array are zero and all effects of the aerodynamic loads on modal response are assumed to be small and therefore neglected. A general approach for calculating the aerodynamic weighting effects is suggested in Appendix B.

All of the arrays used in the flexible body option are in vector form (one dimensional), and the subroutine expects the modal data to appear in a particular order on the data input cards. The order required by the subroutime is best shown through an example. If the aircraft simulated in the program has three landing gear struts and two engines, and four vibratory modes are selected to represent airframe flexibility, then the typical strut and engine attachment point modal data would appear as follows:

Strut 1 Attach Point

Mode	X	Y	Z
1	-.41	.68	-.14
2	.38	.03	.79
3	-.40	-.08	.03
4	-.25	.16	.17

Strut 2 Attach Point

Mode	X	Y	Z
1	-.83	.69	-.33
2	.48	.06	.86
3	-.83	-.07	.05
4	-.47	.17	.38

Strut 3 Attach Point

Mode	X	Y	Z
1	-1.00	.69	-.41
2	.52	.07	.89
3	-1.00	-.08	.05
4	-.55	.17	.49

Engine 1 Attach Point

Mode	X
1	-.64
2	.29
3	-.59
4	-.32

Engine 2 Attach Point

Mode	X
1	-.68
2	.36
3	-.65
4	-.37

Write each component of the strut attachment point mode shape as though in an array dimensioned number-of-struts x number-of-modes.

$$[SXMOD] = \begin{bmatrix} -.41 & .38 & -.40 & -.25 \\ -.83 & .48 & -.83 & -.47 \\ -1.0 & .52 & -1.0 & -.55 \end{bmatrix}$$

$$[SYMOD] = \begin{bmatrix} .68 & .03 & -.08 & .16 \\ .69 & .06 & -.07 & .17 \\ .69 & .07 & -.08 & .17 \end{bmatrix}$$

$$[SZMOD] = \begin{bmatrix} -.14 & .79 & .03 & .17 \\ -.33 & .86 & .05 & .38 \\ -.41 & .89 & .05 & .49 \end{bmatrix}$$

The engine attachment point modal data should be written in an array dimensioned number-of-engines x number-of-modes:

$$[TXMOD] = \begin{bmatrix} -.64 & .29 & -.59 & -.32 \\ -.68 & .36 & -.65 & -.37 \end{bmatrix}$$

Transform each array into vector form by reading the matrix elements by columns. Thus the order in which the data is read would be as follows:

SXMOD =	SYMOD =	SZMOD =	TXMOD =
-.41	.68	-.14	-.64
-.83	.69	-.33	-.68
-1.0	.69	-.41	.29
.38	.03	.79	.36
.48	.06	.86	-.59
.52	.07	.89	-.65
-.40	-.08	.03	-.32
-.83	-.07	.05	-.37
-1.0	-.08	.05	
-.25	.16	.17	
-.47	.17	.38	
-.55	.17	.49	

This data would then be placed on cards according to the format described in the previous section.

Typical aerodynamic data and participation factors would appear as follows:

Aerodynamic Data

Mode	X	Y	Z	θ_X	θ_Y	θ_Z
1	.16	.20	-.89	.0004	.0045	.0009
2	.20	.15	-.96	.0002	.0053	-.0003
3	.12	.08	-.65	-.0001	.0038	.0010
4	.05	.09	-.59	.0003	.0036	-.0007

Participation Factors

Mode	X	Y	Z	θ_X	θ_Y	θ_Z
1	.30	.36	-1.87	.15	-.93	.20
2	.46	.39	2.15	.12	-1.15	-.09
3	.28	.21	-1.13	.04	-.83	.21
4	.16	.24	.97	.08	-.79	-.17

Again, write the data in an array where each column represents the data for a single mode; then read the matrix columnwise.

$$
\text{ARMODE} = \begin{bmatrix} .16 & .20 & .12 & .05 \\ .20 & .15 & .08 & .09 \\ -.89 & -.96 & -.65 & -.59 \\ .0004 & .0002 & -.0001 & .0003 \\ .0045 & .0053 & .0038 & .0036 \\ .0009 & -.0003 & .0010 & -.0007 \end{bmatrix} \qquad \text{PF} = \begin{bmatrix} .30 & .46 & .28 & .16 \\ .36 & .39 & .21 & .24 \\ -1.87 & 2.15 & -1.13 & .97 \\ .15 & .12 & .04 & .08 \\ -.93 & -1.15 & -.83 & -.79 \\ .20 & -.09 & .21 & -.17 \end{bmatrix}
$$

$$
\text{ARMODE} = \begin{array}{l} .16 \\ .20 \\ -.89 \\ .0004 \\ .0045 \\ .0009 \\ .20 \\ .15 \\ \cdot \\ \cdot \\ \cdot \end{array} \qquad \text{PF} = \begin{array}{r} .30 \\ .36 \\ 1.87 \\ .15 \\ -.93 \\ .20 \\ .46 \\ .39 \\ \cdot \\ \cdot \\ \cdot \end{array}
$$

SKC(K) and DCMODE(I) are optional data. The program sets these quantities to zero if not input. SKC(K) is the distance from the tire axle to the strut center of mass measured along the strut stroke. It is approximately equal to zero for many landing gears. The order in which the struts are numbered in SKC(K) must be consistent with the order implied by the strut attachment point mode shapes. If the third row in the modal data represents the motion of the third strut, the third element in array SKC(K) must be the described distance for that strut.

DCMODE(I) defines the mode shape at the drag chute attach point and is necessary only when the aircraft has a drag chute. These modal data are input in an order similar to that for the aerodynamic data. If written in a two-dimensional array, each column of data represents the X, Y, Z components of the mode shape for a given mode.

The remaining input data indicated in Figure 3-6 are necessary to obtain flexible body response output on the airframe. NPTS indicates the number of points at which output is requested. ROIS(J) are the X, Y, Z components of

the position vector defining the location of the points relative to the airframe or 0th body coordinate system. OUTMOD(I) are the components of each mode shape at those points for which output is specified. As before, the order of the data is significant and an example will best show this. If output is desired at two points on the aircraft, typical data would appear as below:

Point 1

Location	Mode	1	2	3	4
X = 2.71	X	.09	.11	-.05	.02
Y = 17.63	Y	.02	.01	-.03	.01
Z = 1.52	Z	.95	-.98	.87	-.77

Point 2

Location	Mode	1	2	3	4
X = 2.71	X	.07	.10	-.04	.01
Y = 8.42	Y	.01	-.02	-.03	-.02
Z = 1.25	Z	.43	-.39	.41	-.29

The matrix ROIS(J) should be written as though dimensioned 3(X,Y,Z) x NPTS and then read by columns. For the above example, ROIS(J) would appear as follows:

ROIS(J) = 2.71, 17,63, 1.52, 2.71, 8.42, 1.25

Each column of OUTMOD(I) should contain all of the modal data for a given point. The X component of data for all modes should procede the Y component, with the Y component preceding the Z. Written in two dimensional form for the example being considered, OUTMOD(I) would be given as:

$$[\text{OUTMOD}] = \begin{bmatrix} .09 & .07 \\ .11 & .10 \\ -.05 & -.04 \\ .02 & .01 \\ .02 & .01 \\ .01 & -.02 \\ -.03 & -.03 \\ .01 & -.02 \end{bmatrix} \begin{matrix} \left.\begin{matrix} \\ \\ \\ \\ \end{matrix}\right\} \text{X Component} \\ \left.\begin{matrix} \\ \\ \\ \\ \end{matrix}\right\} \text{Y Component} \end{matrix}$$

$$\begin{bmatrix} .95 & .43 \\ -.98 & -.39 \\ .87 & .41 \\ -.77 & -.29 \end{bmatrix} \Bigg\} \text{ Z Component}$$

This matrix should be transformed to vector form by reading the elements by column.

The array IFLX(I) dictates which flexible body response data will be saved on tape and used as input for a plot routine. Subroutine FLEX can formulate and print the flexible body response at up to twenty points on the aircraft. IFLX(I) enables the user to select from these points, those whose data will be plotted. Each output point is assigned a number by the order in which their modal data appears in array ØUTMØD(I). An element in IFLX whose value is one will cause the data for that respective point to be placed on tape. For example, if response data is formulated at five points on the aircraft, IFLX = (1, 0, 1, 1, 0) will cause all flexible body data associated with point numbers one, three and four to be saved on tape. Other indicators required to store TOLA output data are discussed in Section 3.3.5. If no flexible body response data is desired, NPTS, RØIS, ØUTMØD and IFLX need not be input.

There is no specific system of units associated with the input information, except for the modal frequencies which must be expressed in radians/unit time. All other parameters may be expressed in any consistent set of units, either English or Metric (inches or centimeters, pounds or dynes). The units selected must, of course, be consistent with the rigid body set used (see Reference 3).

3.3.3 Output Data from the Flexible Body Option - The data that can be output from subroutine FLEX1 consists of the flexible body compouents of the inertial accelerations, velocity and displacement in each of the three body coordinate directions and the total inertial acceleration and velocity in each coordinate direction. The output variable names used in FLEX1 and their definition are given in Figure 3-7.

3.3.4 Staging the Flexible Body Option into the Program - If aircraft elasticity is desired in an analysis, the program will turn the flexible body option subroutine on at the same time the landing gear subroutine is staged

ALL QUANTITIES ARE IN BODY COORDINATES

POINT	-	DEFINES THE POINT NUMBER (1-20)
XD2F	-	X COMPONENT OF THE INERTIAL ACCELERATION DUE TO FLEXIBILITY
XD2T	-	X COMPONENT OF THE TOTAL INERTIAL ACCELERATION
YD2F	-	Y COMPONENT OF THE INERTIAL ACCELERATION DUE TO FLEXIBILITY
YD2T	-	Y COMPONENT OF THE TOTAL INERTIAL ACCELERATION
ZD2F	-	Z COMPONENT OF THE INERTIAL ACCELERATION DUE TO FLEXIBILITY
ZD2T	-	Z COMPONENT OF THE TOTAL INERTIAL ACCELERATION
XD1F	-	X COMPONENT OF THE INERTIAL VELOCITY DUE TO FLEXIBILITY
XD1T	-	X COMPONENT OF THE TOTAL INERTIAL VELOCITY
YD1F	-	Y COMPONENT OF THE INERTIAL VELOCITY DUE TO FLEXIBILITY
YD1T	-	Y COMPONENT OF THE TOTAL INERTIAL VELOCITY
ZD1F	-	Z COMPONENT OF THE INERTIAL VELOCITY DUE TO FLEXIBILITY
ZD1T	-	Z COMPONENT OF THE TOTAL INERTIAL VELOCITY
XDOF	-	X COMPONENT OF DISPLACEMENT DUE TO FLEXIBILITY
YDOF	-	Y COMPONENT OF DISPLACEMENT DUE TO FLEXIBILITY
ZDOF	-	Z COMPONENT OF DISPLACEMENT DUE TO FLEXIBILITY

FIGURE 3–7 OUTPUT VARIABLES USED IN FLEX1

into the program. This is done by testing the values of both the flexible body option indicator (INDFLX) and the landing gear indicator (INDLG). Both must be non-zero for flexibility effects to be included.

Initial generalized displacements are calculated based on values of variables at the time the option is staged into the program. These initial displacements are then used in subsequent calculation of the generalized accelerations.

3.3.5 Data Plotting Information - Major revisions were made to the subroutine that stores data for use by a separate plotting program. As now rewritten, subroutine SDFLGP first prints headers that identify the variable names of the data that follow. These headers are printed only once. Each call to the subroutine then writes to tape all data associated with a single time point. This eliminates the need to store the data in intermediate arrays.

The indicators described in Reference 3 and earlier in this report that control the logic in SDFLGP have not been modified. They are as follows:

IPLT = 1	denotes that data will be stored on tape for plotting
ISDF = 1	indicates rigid body data will be saved
ISTPL1 = 1 ISTPL2 = 1 ISTPL3 = 1 ISTPL4 = 1 ISTPL5 = 1	denotes that data for landing gears number 1 through 5 will be stored on tape
IFLX(I) = 1	indicates that flexible response data for the i th output point will be saved

A new plotting program was developed to be compatible with the data format of the revised TOLA subroutine SDFLGP. This program, entitled PLTDAT, is submitted as a separate job after a data tape has been generated by the TOLA program. The plot tape generated by PLTDAT can then be used by any off-line plotting device. A listing of the PLTDAT computer program is given in Appendix C.

The plot program was designed to permit the user a high degree of flexibility in the use of the program. Any variable stored for plotting may be chosen as the independent variable. Not only does this allow conventional time history plots to be made, but also such plots as the altitude of the

center of gravity versus downrange position or strut acceleration versus strut stroke. A maximum of five dependent variables can be plotted on a single graph. This enables the users to make direct comparisons of several simultaneously displayed variables.

All graphs are scaled to an 8-1/2 x 11 inch page size; however, the actual plotting area depends on the number of dependent variables. The ordinate (dependent variable) axis is six inches in length. The length of the abcissa (independent variable) axis ranges from 9.4 inches for one dependent variable to 7.0 inches for five dependent variables.

The input data required by the plot program must follow a particular format. The first card contains an integer (format I6) that specifies the number of data points plotted per graph. The remaining cards control the number of plots, define graph titles and dictate the dependent and independent variables. This is accomplished by beginning each data card with a control identifier. These control identifiers are TITLE1, TITLE2, INDVAR, DEPVAR and PLOT. All identifiers must begin in column 1 with their associated data beginning in column 11. TITLE1 and TITLE2 permit a 40 character title and subtitle to be printed on the graph. If no titles are desired, these data are omitted. INDVAR defines the variable name on that card as the independent variable. DEPVAR defines a maximum of five variable names (format 5A10) as dependent variables. The word PLOT causes the graphs to be generated with the current titles, dependent and independent variables.

In order to uniquely identify all variables, a two digit numerical prefix is assigned to each repetative data name. For example, if TOLA subroutine SDFLGP has saved data for landing gears one, three, and five, PLTDAT will assign a 01 prefix to all data for gear one, a 02 prefix to all data for gear three, and a 03 prefix to all data for gear five. Thus the strut acceleration for gear five would be 03SD2 while the strut stroke for gear three would be 02S.

Figure 3-8 shows a sample of input data for the plotting program. TOLA subroutine SDFLGP has already saved flexible body data for three points on the aircraft and landing gear data for gear numbers one, three, four and five. The first line in the plotting data indicates that two hundred points will be plotted on each graph. The main title for the first plot is "TOLA TIME HISTORY" while the subtitle is "STRUT ACCELERATIONS". The independent variable is time.

The dependent variables are the strut accelerations corresponding to the first three gears for which data is stored, struts one, three, and four.

```
   200
TITLE1    TOLA TIME HISTORY
TITLE2    STRUT ACCELERATIONS
INDVAR    TIME
DEPVAR    01SD2     02SD2     03SD2
PLOT
TITLE2    STRUT DISPLACEMENTS
DEPVAR    01S       02S       03S
PLOT
TITLE2    FLEXIBLE ACCELERATION - PILOT STATION
DEPVAR    01Z02F
PLOT
```

FIGURE 3-8 SAMPLE OF PLOTTING DATA

For the second graph, no main title is defined so the program uses the current title defined by TITLE1. The subtitle for this plot is "STRUT DISPLACEMENTS" as shown by the TITLE2 card. The independent variable has not been redefined and therefore is still time. The dependent variables are the strut displacements for gears one, three and four.

The third and final plot indicated by these data also uses the current main title but redefines the subtitle as "FLEXIBLE ACCELERATION-PILOT STATION". The independent variable is still time while the single dependent variable is the vertical acceleration at the first flexible body point.

The following standard CalComp plotting routines are called by PLTDAT:

PLOTS	PLOT	SCALE	NUMBER
LABEL	SYMBOL	AXIS	

3.3.6 Comments on Program Operation - In addition to a working knowledge of the program, the user is generally interested in the size of the program

and its operating cost. Using the existing OVERLAY structure, the TOLA computer program with the flexible body option has a core requirement of 67K octal words. Most of the space associated with the flexible body option itself is allocated to store the potentially large quantity of input modal data. Every effort was made during program development to streamline the option.

Program operating costs vary from one computer system to the next so it is not possible to develop a single cost formula. Several observations, however, can be made. The major factors that effect the cost of a TOLA run are the total number of integration steps and the number of variables that need to be integrated. The number of integration steps is dictated by the time length of the analysis and the integration step size. Although the user has little control over the step size chosen by the integration routine, he can directly input the time at which the program will terminate. Care should be taken to insure that the program does not continue to run beyond the points of interest.

Figure 3-9 lists the running time in seconds for five examples used to test the flexible body option. All runs terminated at the same point in the landing analysis so that the differences in cost can be attributed to the number of variables that required integration. A flexible body run adds two variables that require integration for each additional mode. An approximation to determine the time of a flexible body run is given by the expression:

$$(\text{TIME})_{\text{FLEX}} \doteq (\text{TIME})_{\text{RIGID}} \cdot \left(\frac{(\text{NO. OF INTEGRATED VARIABLES})_{\text{FLEX}}}{(\text{NO. OF INTEGRATED VARIABLES})_{\text{RIGID}}} \right)^{1.4}$$

Example Number	CPU Running Time (Sec)
2	1562
3	2217
4	2335
5	2943
6	2560

FIGURE 3-9 TOLA EXAMPLE RUN TIMES

4. EXAMPLES

This section describes the various test cases used to exercise the modified TOLA computer program. It is intended to illustrate actual program operation with emphasis on properly interpreting and incorporating the flexible body data associated with each test case.

A total of six examples are described. The first two cases are rigid body runs that do not include the effects of flexibility, while the remaining four cases employ the flexible body option. Associated with each example are listings of the input data and sample cutput. These data are shown in the appendix section. The input datafiles list all data required for each example. The TOLA computer program does not print the input data in this form since staging data are not printed until the stage is in operation. The output samples shown give the response data for several time points as printed by the program. All of the test cases are summarized in Figure 4-1.

EXAMPLE NUMBER	DATA	OBJECTIVE
1	AIRPLANE A RIGID AIRFRAME	COMPARE RESULTS WITH "AS RECEIVED" TOLA
2	AIRPLANE B RIGID AIRFRAME	REFERENCE RUN
3	AIRPLANE B SIMULATED "RIGID" AIRFRAME	CHECK OPERATION OF FLEXIBLE BODY OPTION
4	AIRPLANE B FLEXIBLE AIRFRAME FOUR MODES	OBTAIN "TYPICAL" FLEXIBLE AIRFRAME RESULTS
5	AIRPLANE B FLEXIBLE AIRFRAME EIGHT MODES	DETERMINE EFFECT OF HIGHER ORDER MODES
6	AIRPLANE B FLEXIBLE AIRFRAME FOUR MODES	EVALUATE EFFECTS OF AERODYNAMICS ON FLEXIBLE BODY RESPONSE

FIGURE 4-1 EXAMPLE RUN SUMMARY

4.1 Rigid Body Examples - Two test cases were run without exercising the flexible body option using different sets of input data. The first set of data, denoted "Airplane A" in Figure 4-1, was originally supplied with the program. The purpose of this run was to check whether the capabilities of the original program had been altered by the addition of the flexible body option. The output from this run compared exactly with the original program results. As can be seen in the input data listing of Appendix D, setting the indicator INDFLX to zero is the only flexible body data required when running a rigid body case.

The second rigid body test case employed a new set of input data supplied by the NASA Langley Research Center. These data are denoted "Airplane B" in Figure 4-1. The program was first exercised as a rigid body run enabling the output to serve as a reference for comparing the effects of flexibility in later cases. Input data and sample output for this example are listed in Appendix E.

4.2 Flexible Body Examples - Four test cases were run to determine the effect that various parameters have on flexible body response. All flexible body data required by each run were taken from data supplied by NASA and shown in Figure 4-2. These data consist of a modal frequency, generalized mass, and modal deflections for sixteen free-free, normal modes. Several observations can be made that help in interpreting program input and results. Only modal deflections in the vertical (Z) direction are given. Consequently, there is no flexible body response in the X and Y directions. In addition, the mode shapes defined by the modal deflections are all symmetric from wing tip to wing tip. This results in a symmetric landing (simultaneous main gear touchdown) since all the rigid body data are also symmetric.

A brief description is given below for each flexible body example. Time history plots of several variables are also shown to illustrate the particular effect emphasized by the test case.

4.2.1 Simulated Rigid Body Run - To obtain results comparable to the rigid body data of Example 2, the flexible body option was first exercised with modal data simulating a stiff airframe. This was accomplished by using the modal deflections and generalized mass associated with the first four modes shown in Figure 4-2 but increasing the modal frequencies by a factor of 20.

MODE NUMBER	MODAL FREQ HZ	MODAL MASS SLUGS	NORMALIZED MODAL DATA - POSITIVE DOWN						
			PILOT STA.	NOSE GEAR	AERO DEF	AERO SLOPE	MAIN GEARS	ENGINE	TAIL
1	2.099	66.6617	+.1970	+.0800	-.1140	-4.239E-4	-.1000	-.0400	+.2030
2	2.628	79.4557	-.0385	-.0200	-.0414	3.643E-4	-.0042	+.1885	-.2440
3	4.784	70.8341	+.0035	-.1530	+.0405	-6.03E-4	+.1393	+.1380	-.1072
4	6.907	18.1131	+.0035	-.0650	+.0644	-3.034E-5	+.0112	-.0510	-.1250
5	7.671	20.0656	+.0254	+.0400	-.0342	-5.653E-5	-.0087	+.0111	+.1998
6	9.728	99.7316	+.3028	+.1850	-.0054	-1.351E-1	+.1200	+.0559	-.4409
7	11.797	70.4027	-.1673	-.0100	-.1258	3.716E-4	+.1050	+.0588	-.0165
8	13.878	31.6212	-.1157	+.0500	-.0323	-9.602E-4	-.0100	+.0350	-.2167
9	15.552	40.4199	+.0494	-.0300	-.0036	7.309E-4	+.0500	+.1025	+.2985
10	17.638	12.1885	-.0038	+.0050	-.0044	8.596E-7	+.0500	+.0100	+.0982
11	20.019	27.2611	+.0370	-.0500	-.0814	5.78E-4	-.0870	-.0200	-.3728
12	21.099	25.7565	+.0181	-.0350	-.0653	2.801E-4	+.0200	+.0075	-.0837
13	23.396	37.8456	+.0135	-.0500	+.0085	1.617E-4	.0000	+.0400	-.1269
14	23.969	39.6848	-.0180	+.0400	-.0009	-1.503E-4	+.0350	+.0250	-.2163
15	25.637	29.5837	-.0072	+.0150	+.0174	-1.417E-4	-.1300	-.0300	+.2243
16	25.694	8.2589	-.0023	+.0075	+.0044	-4.213E-5	-.0320	+.0050	+.0670

PILOT STATION X = 42.6667
NOSE GEAR X = 35.08333
MAIN GEARS X = -2.83867
Y = ±8.3333
Z = 0.509583

ENGINES X = -5.4722
Y = ±14.1667
TAIL X = -32.333

FIGURE 4-2 AIRPLANE B FLEXIBLE BODY DATA

Referring to the input data listing in Appendix F, each modal frequency and generalized mass are placed in arrays GFREQ and GMASS1 respectively. The vertical deflections for each landing gear attach point are in SZMOD. Since there are no other landing gear data, SXMOD and SYMOD are not input. Modal data for the aerodynamic reference point are contained in ARMODE. The aerodynamic weighting factors, PF, were not input, thus eliminating the effect of aerodynamic loads on flexible body response. Engine attach point modal data in the X direction is assumed zero; therefore, TXMOD is not input. Flexible body responses are output for four points on the aircraft, the pilot station, nose gear, right main gear, and tail. Modal data for these points are in OUTMOD, and their position vectors are defined in ROIS.

The output data from this run showed good agreement with that of Example 2, indicating that the flexible body option was operating properly. Differences in rigid body data between these two examples were not distinguishable on a graph; therefore, time history plots of these data are not given.

4.2.2 Flexible Body Run - Four Modes - The flexible body option was then run with the data described for Example 3 but using the actual modal frequencies defined in Figure 4-2. Output data from this run are shown graphically in Figures 4-3 through 4-6 and illustrate the effects of flexibility on aircraft response. These graphs demonstrate that for this example, flexibility has a more significant effect on landing gear dynamics than on rigid body response. It should be noted that the accuracy of all graphs in this section is limited by the time increment at which the data is plotted. Input data and sample output for this example are listed in Appendix G.

4.2.3 Flexible Body Run - Eight Modes - This test case was run to determine the effect of higher order modes on flexible body response. Airframe flexibility was represented by the modal data for the first eight modes of Figure 4-2. The input listing for this example in Appendix H shows the effect that increasing the number of modes has on the arrays associated with the flexible body data. Eight generalized masses and frequencies are shown in GMASS1 and GFREQ, and the size of all arrays containing modal deflections has been increased.

Figures 4-7 through 4-9 compare response data obtained by using four modes and then eight modes to represent airframe elasticity.

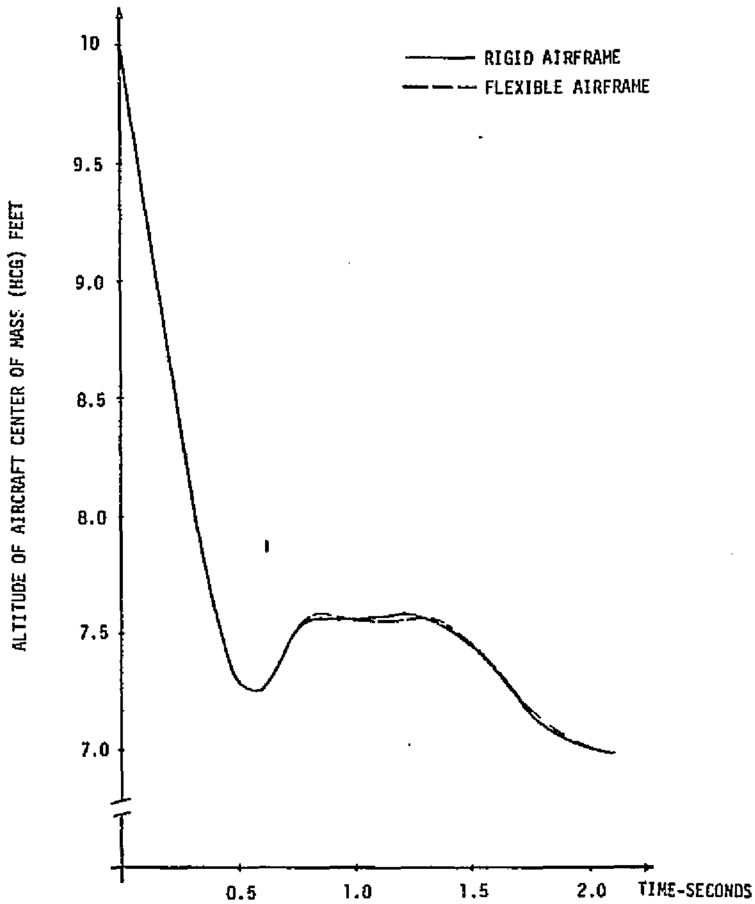

FIGURE 4–3 ALTITUDE OF AIRCRAFT CENTER OF MASS VS TIME

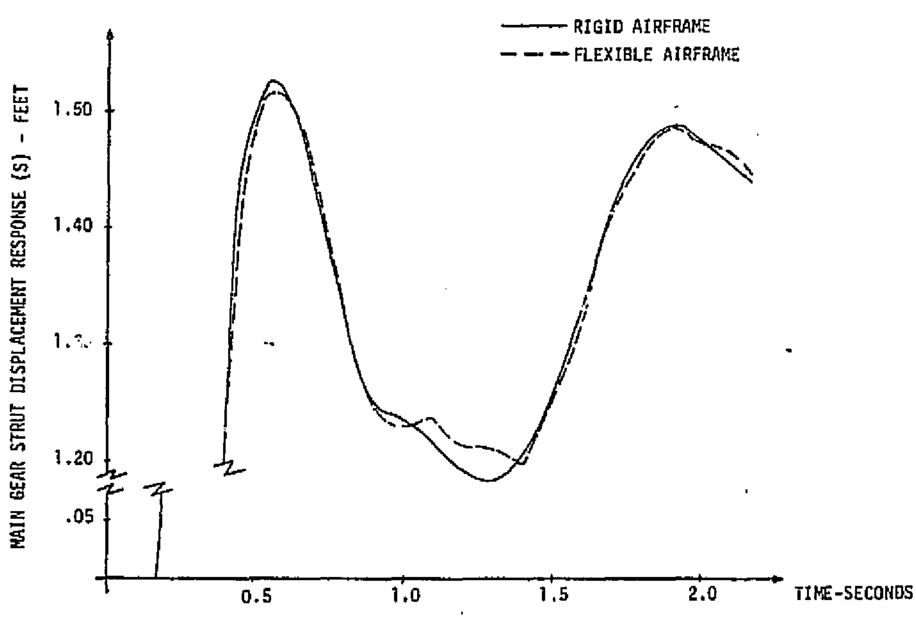

FIGURE 4–4 MAIN GEAR STRUT DISPLACEMENT VS TIME

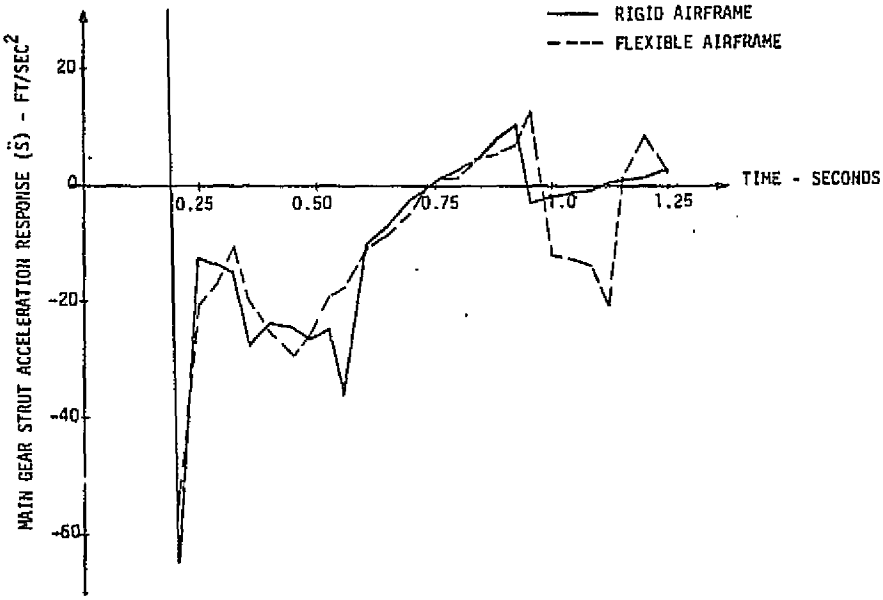

FIGURE 4-5 MAIN GEAR STRUT ACCELERATION VS TIME

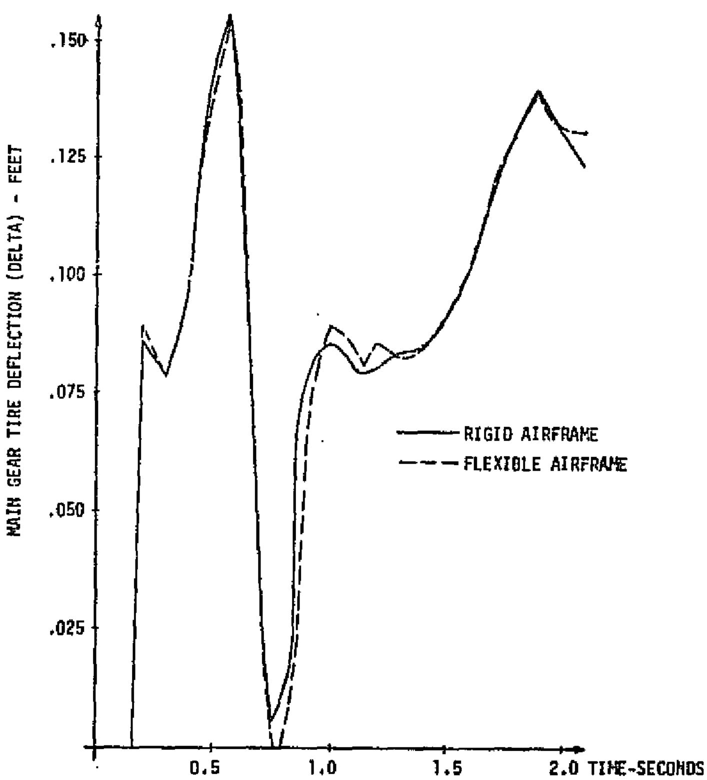

FIGURE 4-6 MAIN GEAR TIRE DEFLECTION VS TIME

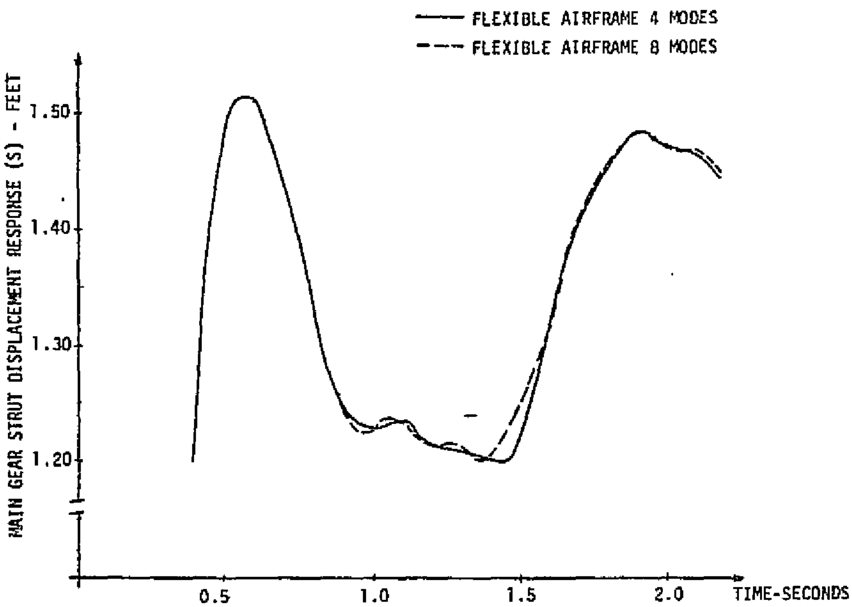

FIGURE 4–7 MAIN GEAR STRUT DISPLACEMENT VS TIME

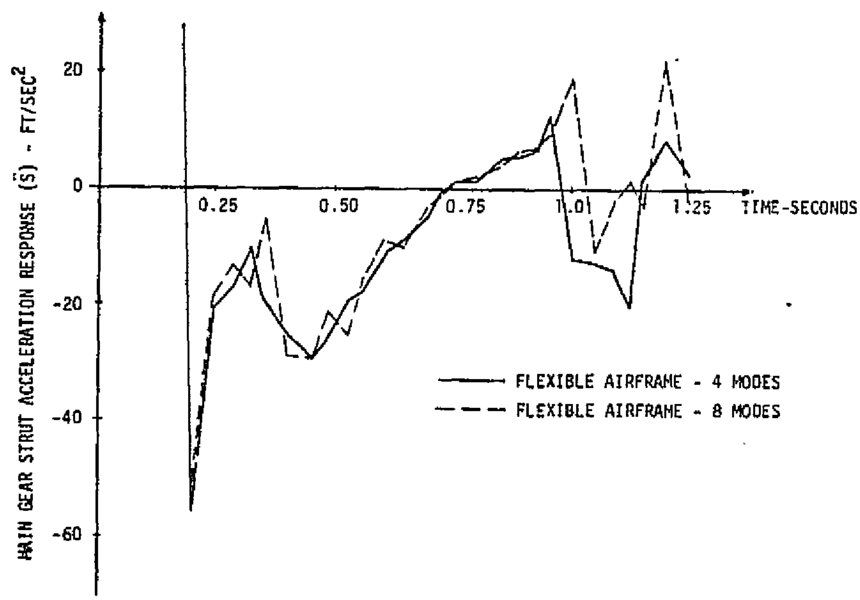

FIGURE 4–8 MAIN GEAR STRUT ACCELERATION VS TIME

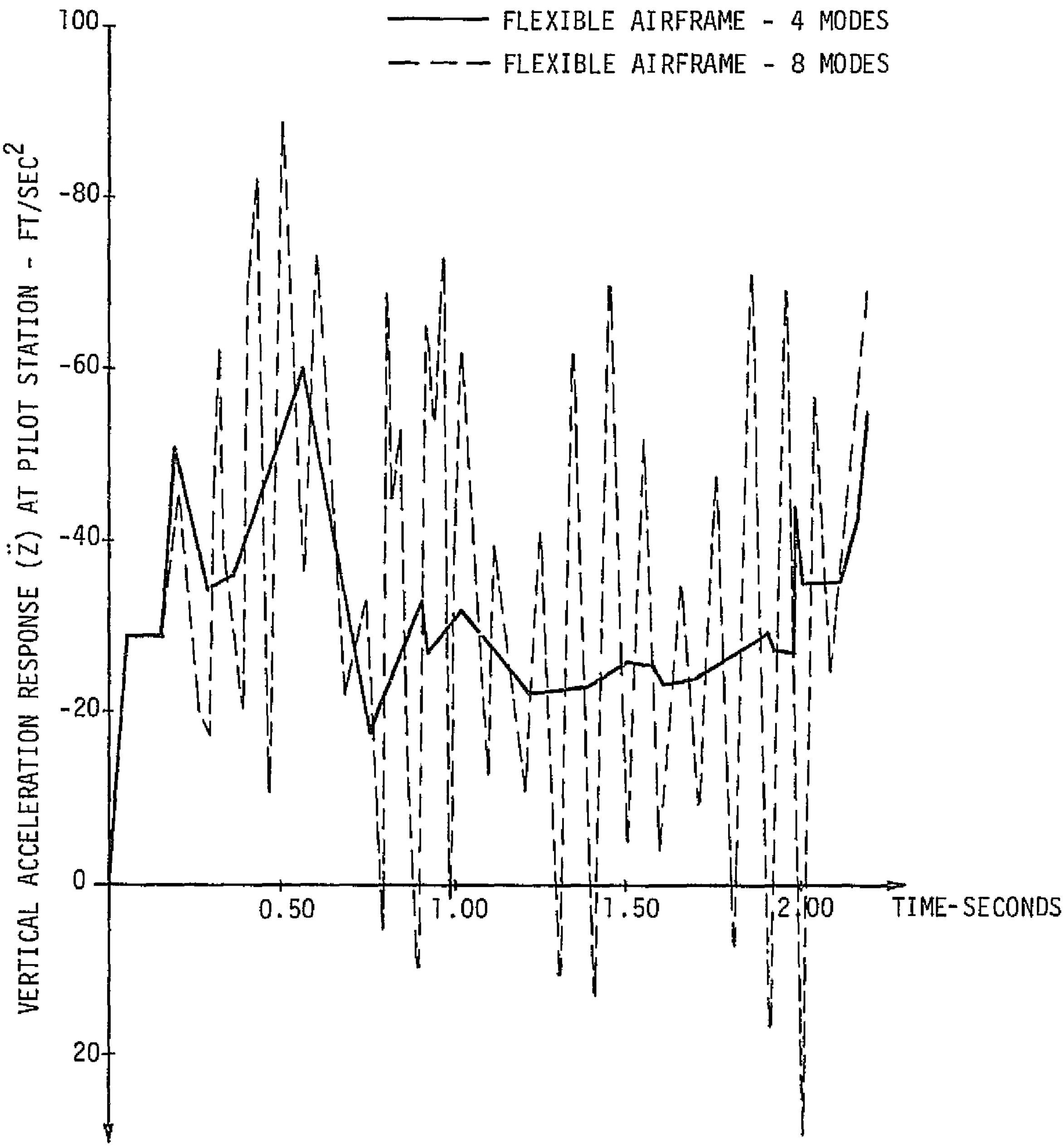

FIGURE 4–9 ACCELERATION RESPONSE AT PILOT STATION VS TIME

4.2.4 Flexible Body Run - Four Modes with Aerodynamic Weighting Factors - Aerodynamic weighting values or participation factors were calculated for each of the first four modes in Figure 4-2 and included in the program to determine the effect of aerodynamic loading on flexible body response. These weighting values were calculated by the method outlined in Appendix B assuming an elliptical spanwise lift distribution over the aircraft's wing. The resulting participation factors with their proper data format are shown with the rest of the flexible body data in the input listing for this example in Appendix I.

Figures 4-10 through 4-12 illustrate the effect that aerodynamic loading has on flexible body response for this airplane.

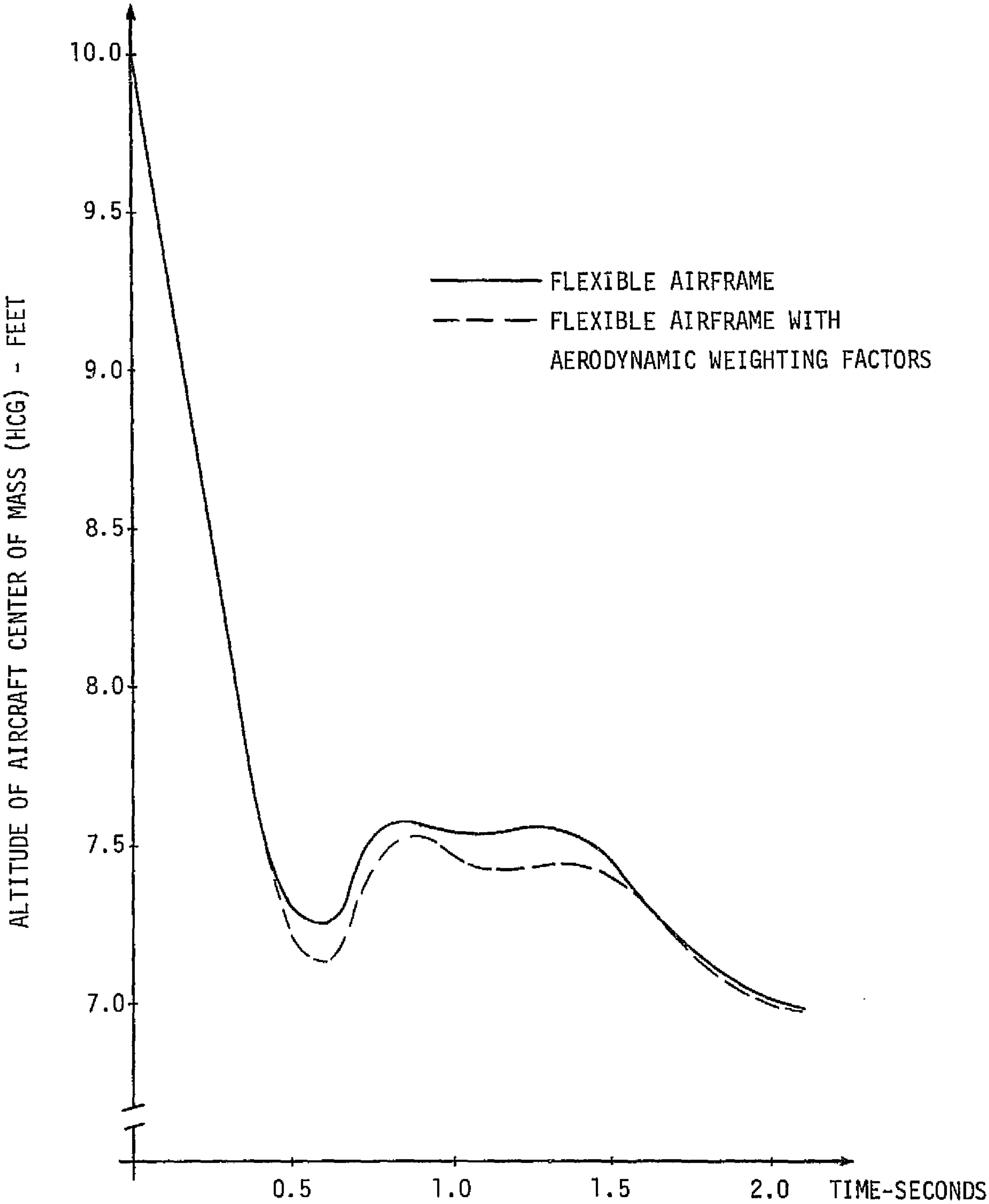

FIGURE 4-10 ALTITUDE OF AIRCRAFT CENTER OF MASS VS TIME

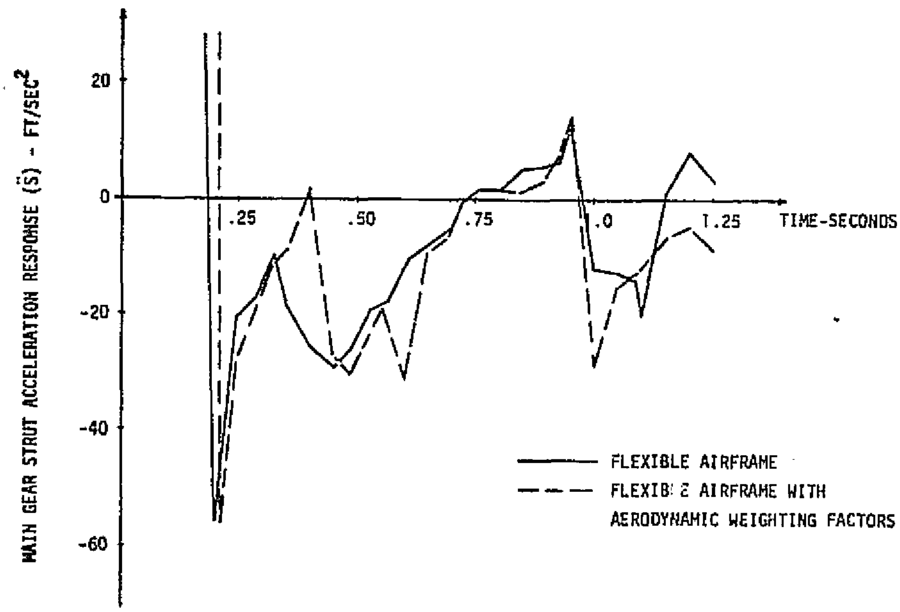

FIGURE 4–11 MAIN GEAR STRUT ACCELERATION VS TIME

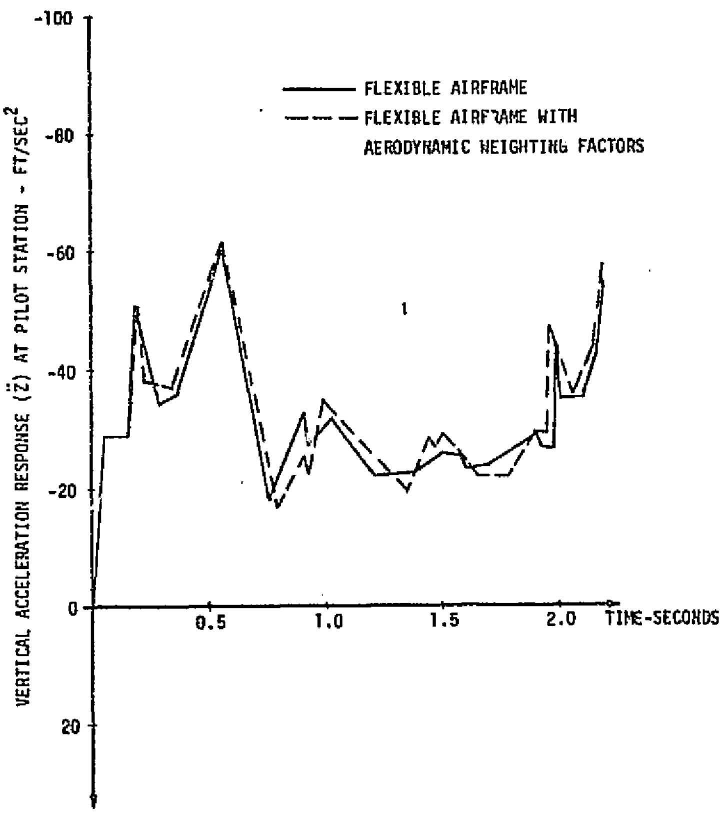

FIGURE 4–12 ACCELERATION RESPONSE AT PILOT STATION VS TIME

5. REFERENCES

1. Lynch, Urban H. D.: "Derivation of the Equations of Motion for the Landing Gear and Ground Reaction Modification to SDF-2," Air Force Flight Dynamics Laboratory, FDMG TM68-5, April 1968.

2. Lynch, Urban H. D.: "Autopilot Equations and Logic for the Takeoff and Landing Analysis Modification to SDF-2," Air Force Flight Dynamics Laboratory, FDMG TM68-11, October 1968.

3. Lynch, Urban H. D.: "Users Manual for the Takeoff and Landing Analysis Computer Program," Air Force Flight Dynamics Laboratory, FDMG TM68-12, March 1969.

4. Lynch, Urban H. D.: "Takeoff and Landing Analysis (TOLA) Computer Program," Part 1, Air Force Flight Dynamics Laboratory Technical Report, AFFDL-TR-71-155, Part 1, February 1972.

5. Dick, J. W. and Benda, B. J.: "Addition of Flexible Body Option to the TOLA Computer Program, Part II - User and Programmer Documentation", NASA CR-132732, October 1975

APPENDIX A

PROGRAM LISTING - TOLA COMPUTER PROGRAM

WITH FLEXIBLE BODY OPTION

```
      OVERLAY(TOLA,0,0)
      PROGRAM TOLA(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,
     1TAPE13,TAPE16,TAPE31)
      COMMON/TABDIR/TABLE(800)
      COMMON/READ1/DM1(64),JBC,INXQ
      CALL FTN3IN(1,0,DUMMY)
      REWIND 13
C     READ SUBROUTINE INITIALIZATION
      JBC=-1
      INXQ=0
 1    CALL EXE
      GO TO 1
      END
      SUBROUTINE EXE
C             EXECUTIVE PROGRAM
      DIMENSION IMTHD(1)
      LOGICAL INDARC , END , SKIPUP
      LOGICAL STSWCH , TABSTP
      COMMON  /STOPIT/ STSWCH , TABSTP
      COMMON /DIFCOM/
     *        SKIPUP       ,H0          ,T               ,TIMINT      ,DM1(4)      ,
     *        AMINER       ,AMAXER      ,
     *RELER1,DM7(5),RELER2,DM2(7),AINCRS(4),DM4(46),TIMER,DM3(64),
     *        AMAXH        ,DM11   (180),DECRES(  4),
     *        DM13   (  8),DELTS        ,DM14   (  6),DLH1        ,DM15   (  4),
     *DLTM1,DLTM2,DLTM3,DM16(18),EPS1,DM8,
     *        EPS11        ,DM21         ,EPS13         ,DM22   ( 12),EPS25        ,
     *        DM23         ,EPS53        ,DM24          ,EPS55        ,DM25         ,
     *        EPS7         ,DM26         ,EPS9          ,DM27   ( 25),GREFF        ,
     *DM28(17),HCC7F,DM29(44),
     *        INDACR       ,DM31   (  2),INDARC        ,DM32         ,
     *INDATM,INDAUT,DM33(123),INDPSK,DM38(34)
      COMMON /DIRCOM/
     *        INDSKP       ,DM40          ,INDSTE       ,INDSTF       ,INDSTG      ,
     *        DM41   (  2),INDSTR        ,INDSTY       ,DM42         ,INDTFF      ,
     *        DM43         ,INDVPC        ,DM44   (  9),
     *        NSTAGE       ,DM46   (  3),DMGPR         ,DM47   ( 63),REP    ( 30),
     *        RE77F        ,DM48   ( 28),RP77F         ,DM50   ( 14),
     *DM51(6),SIGN,DM52(56),TIME,DM9(2),
     *        TIMES        ,DM55   (  3),TIMSX         ,DM56         ,TL1         ,
     *        TL11         ,TL12          ,TL13         ,TMAX         ,DM57   (127),
     *        PRINT        ,DM58   (  6),STGVAR(  2),DM59   ( 13),
     *DM60(277),NSTRUT,DM63(89),IL,DM62(215),ALPDES,DM61(111),
     *INDLG,DM10(151),DDM(2068)
      COMMON/TABSRC/DUMM0(110)
      COMMON/EXCAUT/ADD1M1,SWT1,TIME1,ALPOD1,DUMM1(5)
      COMMON/LG/IDM3(7)
      COMMON/AUTSC/IDM4(40)
      COMMON/AUTPRC/IDM5(63)
      COMMON/LGAUTS/IDM6(14)
      COMMON/FLXUP/IDM1(608)
      COMMON/AUTSAC/ALPDR1,DDESR,DUMM3(4)
      COMMON/HTCOM/HT,HT1,HT2
      COMMON/CONTRO/ICONTR,CONTR1,ICONT2,ICONT3
      LOGICAL SWT1,SWT2,SWT3
      EQUIVALENCE (IMTHD , SKIPUP)
      DATA STCOM2,STCOM3,BLANK/4HTMAX,5HSTAGE,6H      /
 1    FORMAT (1H0,15X,1.A6/(1H ,15X,10A6))
 3    FORMAT (1H0,15X,4HSTOP)
 7    FORMAT (1H0,15X,16HSTAGE DATA ERROR)
 9    FORMAT (1H0,15X,11H STAGE ON--,2A6)
 10   FORMAT (1H0,15X,5HSTOP- A6)
C     ***********************************************************
C     INITIALIZATION BEFORE DATA READ FOR ALL SUBPROGRAMS
C     ***********************************************************
```

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```
35    DO 35 II=1,3959
      IMTHO(II) = 0
      DO 36 II=1,30
36    REM(II)=BLANK
      DO 100 II=1,4
      AINCRS(II)=BLANK
100   DECRES(II)=BLANK
      DO 20 I=1,40
20    IOM4(I)=0
      DO 21 I=1,63
21    IOM5(I)=0
      DO 23 I=1,14
23    IOM6(I)=0
      DO 24 I=1,608
 24   IBH1(I)=0
      CALL LGEAR1
      CALL TFFS1
      CALL VPCS1
      CALL SAGS1
      CALL OPT1
      CALL FLEX1
      SWT2=.FALSE.
      SWT3=.TRUE.
      NSTAGE=1
      INDSTE=1
      INDATM=1
      SIGN=1.
      AMAXH=1.E6
      DELTS=.1
      PRINT=1.
      DLTM1=.0001
      DLTM2=.0001
      TIMER=30.
      DLH1=1.
      EPS1=1.
      EPS3=1.
      EPS5=1.
      EPS7=1.
      EPS9=1.
      EPS11=1.
      EPS13=1.
      EPS15=1.
      OMGPP=7.292115)8E-5
      RE77F=20926428.
      RP77F=20855965.
      RELER1 = .00007
      RELER2 = .000005
      AMINER = .001
      AMAXER=10000.
      TIMINT = AMINER
      DLTM3=.001
      GREFF=32.174
C     AUTS SUBROUTINE INITIALIZATION
      SWT1=.TRUE.
      ALPDO1=0.
C     AUTS - SAGS SUBROUTINES INITIALIZATION
      ALPOR1=0.
      QDESR=0.
C     ********************************
C     POST DATA INITIALIZATION AND PRINT
C     ********************************
 264  ICONTR=1
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
 266  CALL STGTSI
   1  CALL DEF
```

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```
      INOSKP=0
      H0=DELTS
      IF (TIMINT .LT. AMINER) TIMINT = AMINER
      CALL INPUZ
      IF(SWT2)GO TO 302
C     AUTS SUBROUTINE INITIALIZATION
      ADDIM1=ALPDES
      TIME1=TIME
C
      HT=DELTS
      HT1=HT
      HT2=HT
      SWT2=.TRUE.
 302  T=TIME
      TL1=TIME
      TL11=TIME
      TL12=TIME
      TL13=TIME
      TIMES=TIME-TIMSX
      INJARC = HGC7F .GT. AMAXH
      CALL LINES (13)
      WRITE (6,1) (REM(I),I=1,30)
      IF(INOVPG.EQ.0)GO TO 303
      ICONTR=4
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
 303  IF(INOTFF.EQ.0)GO TO 304
      ICONTR=2
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
 304  IF(INDAC7.EQ.0)GO TO 305
      ICONTR=3
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
 305  ICONTR=5
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
      IF(INOLG.EQ.0)GO TO 306
      ICONTR=6
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
 306  SKIPUP=.TRUE.
      CALL VPCS2
C     POST DATA INITIALIZATION FOR SUBPROGRAMS
      CALL LGEAR2
      CALL OPT2
      CALL FLEX2
 413  CALL OPT7
      CALL SUFLGP
      CALL OPT6
      IF(INOAUT.EQ.0)GO TO 307
      ICONTR=2
      CALL OVERLAY(4LTOLA,2,0,6HRECALL)
 307  SKIPUP=.FALSE.
      END = .FALSE.
      TIMEA=DELTS+T-1.E-6
      TIMEP=PRINT+T-1.E-6
C     *****************
C     EXECUTIVE PROGRAM
C     *****************
 412  TPD = T+DELTS
      IF (TPD .LT. TMAX) GO TO 413
      DELTS = TMAX-T
      H0    = DELTS
      END = .TRUE.
 413  CALL HIMIN(MIM)
      IF(MIM.NE.0)GO TO 415
      CALL SOFLGP
      IF(INOSTC.EQ.0)GO TO 417
      IF(END)GO TO 417
```

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```
      IF(INDSTG.NE.0)GO TO 417
      TIMEA=T+DELTS-1.E-6
      IF(T.LT.TIMEP)GO TO 414
      TIMEP=T+PRINT-1.E-6
      CALL OPT6
      IF(INDAUT.EQ.0)GO TO 416
      ICONTR=2
      CALL OVERLAY(4LTOLA,2,0,6HRECALL)
      GO TO 415
414   IF(INDAUT.EQ.0)GO TO 416
      ICONTR=1
      CALL OVERLAY(4LTOLA,2,0,6HRECALL)
      GO TO 416
415   CALL SDFLGP
      IF(T.LT.TMAX)END=.FALSE.
      IF(INDSTG.EQ.0)GO TO 417
      IF(END)GO TO 417
      IF(INDSTG.NE.0)GO TO 417
      CALL OPT5
      TIMEP=T+PRINT-1.E-6
      IF(T.LT.TIMEA)GO TO 416
      TIMEA=T+DELTS-1.E-6
      IF(INDAUT.EQ.0)GO TO 416
      ICONTR=2
      CALL OVERLAY(4LTOLA,2,0,6HRECALL)
      GO TO 415
417   CALL OPT6
      IF(INDAUT.EQ.0)GO TO 416
      ICONTR=2
      CALL OVERLAY(4LTOLA,2,0,6HRECALL)
416   IF (INDSTG .EQ. 0) GO TO 744
      IF (      END       ) GO TO 743
      IF (INDSTG .EQ. 0) GO TO 412
C     *************
C     STAGING IS REQUIRED
C     *************
511   INDSTG = 0
      CALL LINES (2)
      WRITE (6,9) (STGVAR(I),I=1,2)
524   DO 525 JJ=1,4
      AINCPS(JJ)=BLANK
525   DECRES(JJ)=BLANK
      IF(INDSTF.EQ.0) GO TO 537
      INDSTF=0
      CALL LINES (2)
      WRITE (6,10) STCOM3
      GO TO 744
537   INDSKP=1
      CALL DEF
      ICONTR=1
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
C     STAGE DATA IS READ - TEST MAJOR OR MINOR
543   INDSKP=0
572   IF(INDSTY.NE.0) GO TO 601
      CALL STGTST
      T=TIME
      H0= DELTS
      SKIPUP = .TRUE.
      IF(SNT3)GO TO 22
      IF(INDLG.NE.2)GO TO 22
      NDEFS=5*NSTRUT
      IF(IL.NE.0)NDEFS=3*NSTRUT
      CALL LNUPD(NDEFS)
      SNT3=.TRUE.
      IF(ISIGN(1,INDLG).GT.0)GO TO 410
```

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```
      SHI3=.FALSE.
      INDLG=-INDLG
      ICONTR=6
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
      CALL LGEAR2
      CALL LGEAR3
      CALL FLEX2
      GO TO 41.
601   INDSTY=0
      CALL DEF
      IF (INDSTR.EQ.0) GO TO 604
      INDSTR=0
      TIMSX=T
      NSTAGE=NSTAGE+1
604   IF (ISIGN(1,INOVPC).GT.0) GO TO 605
      CALL VPCS1
      INOVPC=-INOVPC
      ICONTR=4
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
605   IF (ISIGN(1,INDTFF).GT.0) GO TO 608
      CALL TFFS.
      INDTFF=-INDTFF
      ICONTR=2
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
608   IF (ISIGN(1,INDALR).GT.0) GO TO 264
      CALL SACS1
      INDAER=-INDAER
      ICONTR=3
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
      GO TO 264
743   CALL LINES (2)
      WRITE (6,1.) STCOM2
C744            GENERAL STOP
744   CALL LINES (2)
      WRITE (6,3)
      STSWCH=.TRUE.
      CALL LGEAOP
      RETURN
      END
      SUBROUTINE INUPD (N,L)
      INTEGER L(1)
      COMMON/DIRCOM/SKIPUP(646),INDSTE(1245),DH(2068)
      COMMON /UPDCAL/ NUM , P( 90),Y( 90)
      IF (NUM+N .LE. 90) GO TO 5
      CALL DEF
      WRITE (6,700)
700   FORMAT(55H NUMBER OF INTEGRATION VARIABLES EXCEEDS MAX LIMIT   90)
      STOP
5     DO 20 I= 1,N
      NUM = NUM +1
20    L(I) = NUM
      RETURN
      END
      SUBROUTINE LNUPD(MN)
      COMMON/UPDCAL/NUM,P(90),Y(90)
      NUM=NUM-MN
      RETURN
      END
      SUBROUTINE INPUZ
      COMMON/UPDCAL/NUM,P(90),Y(90)
      NUM     = 0
9     DO 10 I=1,90
      P(I) = 0.
10    Y(I) = 0.
      RETURN
```

```
      END
      SUBROUTINE INTEG(K,XD)
      COMMON/UPDCAL/NUM,P(90),Y(90)
      P(K) = XD
      RETURN
      END
      SUBROUTINE UPDAT (JX1,JX2,XJ1,XJ2,XJ3,XJ4,XJ5)
      COMMON/DIRCOM/SKIPUP,DM(645),INDSTE(1245),DM1(2068)
      COMMON/UPDCAL/NUM,P(90),Y(90)
      LOGICAL SKIPUP
      IF (SKIPUP) GO TO (200,201,202,203,204) , JX1
                  GO TO (100,101,102,103,104) , JX1
104   XJ5 = Y(JX2+4)
103   XJ4 = Y(JX2+3)
102   XJ3 = Y(JX2+2)
101   XJ2 = Y(JX2+1)
100   XJ1 = Y(JX2  )
      RETURN
204   Y(JX2+4) = XJ5
203   Y(JX2+3) = XJ4
202   Y(JX2+2) = XJ3
201   Y(JX2+1) = XJ2
200   Y(JX2  ) = XJ1
      RETURN
      END
      SUBROUTINE MIMIN(MIM)
      LOGICAL SW
      COMMON/DIRCOM/F,DX,X,STOPIT,IVARBH,SW,DM1(2),DXMIN,
     *DXMAX,RELER1,DM2(5),RELER2,DM3(629),INDSTE,DM4(930),
     *PRTMIN,DM5(161),INDLG,DM6(151),DM7(2068)
      COMMON/UPDCAL/N,P(90),Y(90)
      COMMON/HTCOM/HT,HT1,HT2
      DIMENSION YMAX(90),Y0(90),P0(90),S(90),YP(90),Y1(90),Z(90),
     CXK(90,3)
      MIM=0
      ACH=0.
      XF=X+DX
      IF (IVARBH .NE. 0) GO TO 300
      X0=X
      DO 20 I=1,N
20    YMAX(I)=ABS(Y(I))
30    H=AMIN1(HT,HT1,HT2)
40    X=X0
      H=AMIN1(ABS(H),ABS(DXMAX))
      DO 50 I=1,N
50    Y0(I)=Y(I)
      CALL OPT7
      CALL OPT4
      IF(SW.OR.(INDSTE.EQ.0))GO TO 360
      DO 60 I=1,N
      P0(I)=P(I)
60    Y(I)=Y0(I)+0.5*H*P0(I)
      X=X0+0.5*H
      CALL OPT7
      CALL OPT4
      IF(INDSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 80 I=1,N
      S(I)=2.0*P(I)+P0(I)
80    Y(I)=Y0(I)+0.5*H*P(I)
      CALL OPT7
      CALL OPT4
      IF(INDSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 90 I=1,N
```

```
      S(I)=2.0*P(I)+S(I)
90    Y(I)=Y0(I)+H*P(I)
      X=X0+H
      CALL OPT7 '
      CALL OPT4
      IF(INOSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 100 I=1,N
100   YP(I)=Y0(I)+H*(P(I)+S(I))/6.
110   X=X0+0.25*H
      DO 120 I=1,N
120   Y(I)=Y0(I)+0.25*H*P0(I)
      CALL OPT7
      CALL OPT4
      IF(INOSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 130 I=1,N
      S(I)=2.0*P(I)+P0(I)
130   Y(I)=Y0(I)+0.25*H*P(I)
      CALL OPT7
      CALL OPT4
      IF(INOSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 140 I=1,N
      S(I)=2.0*P(I)+S(I)
140   Y(I)=Y0(I)+0.5*H*P(I)
      X=X0+0.5*H
      CALL OPT7
      CALL OPT4
      IF(INOSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 150 I=1,N
      Y1(I)=Y0(I)+0.5*H*(P(I)+S(I))/6.
150   Y(I)=Y1(I)
      CALL OPT7
      CALL OPT4
      IF(SW.OR.(INOSTE.EQ.0))GO TO 360
      DO 160 I=1,N
      S(I)=P(I)
160   Y(I)=Y1(I)+0.25*H*P(I)
      X=X0+0.75*H
      CALL OPT7
      CALL OPT4
      IF(INOSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 170 I=1,N
      S(I)=2.0*P(I)+S(I)
170   Y(I)=Y1(I)+0.25*H*P(I)
      CALL OPT7
      CALL OPT4
      IF(INOSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      DO 180 I=1,N
      S(I)=2.0*P(I)+S(I)
180   Y(I)=Y1(I)+0.5*H*P(I)
      X=X0+H
      CALL OPT7
      CALL OPT4
      IF(INOSTE.EQ.0)GO TO 360
      IF(SW.AND.(H.GT.STOPIT)) GO TO 270
      R=0.0
      DO 190 I=1,N
      Y(I)=Y1(I)+0.5*H*(P(I)+S(I))/6.
      ERR =(Y(I)-YP(I))/15.0
      Z(I)=AMAX1(YMAX(I),ABS(Y(I)))
```

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```
      R = AMAX1( R,ABS(ERR) / AMAX1( Z(I) ,1.0) )
      IF(RELER1 -R)185,190,190
185   IF(ABS(H).GT.ABS(DXMIN)) GO TO 270
190   YMAX(I)=Z(I)
      IF(INDLG.NE.0)CALL LGDET
      IF(SW)GO TO 360
205   X0=X0+H
      IF(ABS(XF-X0).GT.1.E-10)GO TO 211
210   CALL OPT7
      CALL OPT4
      GO TO 360
211   IF(H.GT.PRTMIN)GO TO 212
      ACH=ACH+H
      IF(ACH.GE.PRTMIN)GO TO 213
      GO TO 220
213   CALL OPT7
      CALL OPT4
      HT=H
      CALL LINES(1)
      WRITE(6,700)HT
700   FORMAT(22H INTEG RTN.        HT = ,E15.8)
      MIM=1
      RETURN
212   ACH=0.
220   IF(R-RELER2  )230,230,240
230   H=H+H
240   IF(ABS(H).LE.ABS(XF-X0)) GO TO 40
250   HT=H
      H=XF-X0
      GO TO 40
270   H=0.5*H
      DO 280 I=1,N
280   YP(I)=Y1(I)
      GO TO 10
300   KF=IFIX(DX/DXMIN)
      H=DX/ABS(FLOAT(KF))
      K=0
305   K=K+1
      DO 310 I=1,N
310   Y0(I)=Y(I)
      CALL OPT7
      CALL OPT4
      IF(SW.OR.(INDSTE.EQ.0))GO TO 360
      X=X+0.5*H
      DO 330 J=1,2
      DO 320 I=1,N
      XK(I,J)=H*P(I)
320   Y(I)=Y0(I)+0.5*XK(I,J)
      CALL OPT7
330   CALL OPT4
      IF(INDSTE.EQ.0)GO TO 360
      X=X+0.5*H
      DO 340 I=1,N
      XK(I,3)=H*P(I)
340   Y(I)=Y0(I)+XK(I,3)
      CALL OPT7
      CALL OPT4
      IF(INDSTE.EQ.0)GO TO 360
      DO 350 I=1,N
350   Y(I)=Y0(I)+(XK(I,1)+2.*(XK(I,2)+XK(I,3))+H*P(I))/6.
      IF(K.LT.KF) GO TO 305
      X=XF
      IF(INDLG.NE.0)CALL LGDET
      CALL OPT7
      CALL OPT4
```

```
0     CALL LINES(1)
      WRITE(6,730)HT
      RETURN
      END
      SUBROUTINE LGOET
      COMMON/UPOCAL/NUM,P(90),Y(90)
      COMMON/LGOE/LA(29),FC2(5),P2(5),PRES(5),C(5),IPPT,LTPT
      COMMON/DIRCOM/DM1(646),INDSTE(675),NSTRUT,DM2(84),
     CA2(5),IL,S2T(5),ES2(5),
     COM3(5),MASS2(5),DM5(34),ES(5),SB(5),DM4(131),IB(5),DM6(127),
     CINOLG,DM7(151),DM8(2068)
      COMMON/HTCOM/HT,HT1,HT2
      REAL MASS2
      IF(INOLG.EQ.2)RETURN
      DO 10 I=1,NSTRUT
      K=2*I+NSTRUT
      J=LA(K)
      KK=K-1
      JJ=LA(KK)
      L=KK+2*NSTRUT
      LL=LA(L)
      M=K+2*NSTRUT
      MM=LA(M)
      NN=LA(I)
      HT1=HT
      IF(P(J))76,77,78
76    TTIME=Y(J)/ABS(P(J))
79    IF(TTIME.GE.HT)GO TO 77
      HT1=TTIME
      GO TO 77
78    TTIME=(SB(I)-Y(J))/P(J)
      GO TO 79
77    CONTINUE
      IF(Y(J).GT.(-ES(I)))GO TO 50
      WRITE(6,49)I,I,Y(J)
49    FORMAT(58X,4H-ES(,I1,10H) EXCEEDED/
     C58X,2HS(,I1,4H) = E15.7)
50    IF(Y(J).LE.ES(I))GO TO 51
      IF(Y(J).LE.(SB(I)-ES(I)))GO TO 55
      IF(Y(J).LE.(SB(I)+ES(I)))GO TO 52
      WRITE(6,53)I,I,Y(J)
53    FORMAT(58X,4H ES(,I1,10H) EXCEEDED/
     C58X,2HS(,I1,4H) = E15.7)
52    IF(Y(JJ).LE.0.)GO TO 20
      Y(JJ)=0.
      P(J)=0.
20    IF(P(JJ).LT.0.)GO TO 55
      P(JJ)=0.
      GO TO 55
51    IF(Y(JJ).GE.0.)GO TO 21
      Y(JJ)=0.
      P(J)=0.
21    IF(P(JJ).LT.0.)P(JJ)=0.
55    CONTINUE
      IF(IL.NE.0)GO TO 60
      HT2=HT
      IF(P(MM))86,87,88
86    TTIME=Y(MM)/ABS(P(MM))
89    IF(TTIME.GE.HT)GO TO 87
      HT2=TTIME
      GO TO 87
88    TTIME=(S2T(I)-Y(MM))/P(MM)
      GO TO 89
87    CONTINUE
      IF(Y(MM).GT.(-ES2(I)))GO TO 58
```

```
      WRITE(6,57)I,I,Y(MM)
57    FORMAT(58X,5H-ES2(,I1,10H) EXCEEDED/
     C58X,3HS2(,I1,4H) = E15.7)
58    IF(Y(MM).LE.ES2(I))GO TO 61
      IF(Y(MM).LE.(S2T(I)-ES2(I)))GO TO 60
      IF(Y(MM).LE.(S2T(I)+ES2(I)))GO TO 62
      WRITE(6,63)I,I,Y(MM)
63    FORMAT(58X,5H ES2(,I1,10H) EXCEEDED/
     C58X,3HS2(,I1,4H) = E15.7)
62    IF(Y(LL).LE.0.)GO TO 22
      Y(LL)=0.
      P(MM)=0.
22    IF(P(LL).LT.0.)GO TO 60
      GO TO 140
61    IF(Y(LL).GE.0.)GO TO 23
      Y(LL)=0.
      P(MM)=0.
23    IF(P(LL).GE.0.)GO TO 60
140   P(LL)=0.
60    CONTINUE
      IF(IB(I).NE.(-1))GO TO 10
      P(NN)=0.
      Y(NN)=0.
10    CONTINUE
      RETURN
      END
      SUBROUTINE STGTS1
      LOGICAL SH
      COMMON /DIRCOM/
     *COMVAL(5 ) , SH(19) , AINCRS(4) , DM2(292) , DECRES(4) , DM3(510),
     *STEST ( 4) , STESTD(4) , DM4(187) , STGVAR(4) , DM5(543),
     *ISTAGE,DM6(314),DM7(2068)
      COMMON/STGT/ICOUNT,KCOUNT,LOCAIN(4),LOCADE(4)
      COMMON/CONTRO/ICONTR,CONTR1,ICONT2,ICONT3
      DATA BLANK/1H /
      ICOUNT = 0
      KCOUNT = 0
      DO 10 I=1,4
      IF (AINCRS(I) .EQ. BLANK) GO TO 15
      ICONTR=8
      CONTR1=AINCRS(I)
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
      LOCAIN(I)=ICONT2
      IF(ICONT3.EQ.0)GO TO 12
      WRITE (6,11) AINCRS(I)
11    FORMAT (28H ERROR.THE STAGE VARIABLE **A6,
     *        26H** IS NOT IN THE DIRECTORY/24H0...LOOKING FOR NEW CASE)
      CALL EXERR(0)
      RETURN
12    ICOUNT = ICOUNT+1
10    CONTINUE
15    DO 20 I=1,4
      IF (DECRES(I) .EQ. BLANK) GO TO 21
      ICONTR=8
      CONTR1=DECRES(I)
      CALL OVERLAY(4LTOLA,1,0,6HRECALL)
      LOCADE(I)=ICONT2
      IF(ICONT3.EQ.0)GO TO 24
      WRITE (6,11) DECRES(I)
      CALL EXERR(0)
      RETURN
24    KCOUNT = KCOUNT+1
20    CONTINUE
21    RETURN
      END
```

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```
      SUBROUTINE STGTST(INDSTG)
      COMMON/DIRCOM/
     1COMVAL(5),SW,DM1(18),AINCRS(4),DM2(292),DECRES(4),DM3(510),
     2STEST(4),STESTD(4),DM4(187),STGVAR(4),DM5(543),ISTAGE,DM6(314),
     3DM7(2098)
      COMMON/STGT/ICOUNT,KCOUNT,LOCAIN(4),LOCADE(4)
      LOGICAL SW
      DATA AINCR,ADECR/5HINCR.,5HDECR./
22    IF (ICOUNT.EQ.0) GO TO 30
      IF(ISTAGE.EQ.0)GO TO 61
      DO 60 I=1,ICOUNT
      J=LOCAIN(I)
      IF(COMVAL(J).NE.STEST(I))GO TO 30
60    CONTINUE
      GO TO 40
61    DO 23 I=1,ICOUNT
      J = LOCAIN(I)
      IF (COMVAL(J) .GE. STEST (I) ) GO TO 40
23    CONTINUE
30    IF (KCOUNT .EQ. 0) GO TO 33
      IF(ISTAGE.EQ.0)GO TO 64
      DO 65 I=1,KCOUNT
      J=LOCADE(I)
      IF(COMVAL(J).NE.STESTD(I))GO TO 33
65    CONTINUE
      GO TO 50
64    DO 32 I=1,KCOUNT
      J = LOCADE(I)
      IF (COMVAL(J) .LE. STESTD(I) ) GO TO 50
32    CONTINUE
33    INDSTG = 0
      SW = .FALSE.
      RETURN
40    STGVAR(2)=AINCRS(I)
      STGVAR(1)=AINCR
      GO TO 51
50    STGVAR(2)=DECRES(I)
      STGVAR(1)=ADECR
51    INDSTG = 1
      SW = .TRUE.
      RETURN
      END
      BLOCK DATA TDATA
      COMMON/TABCOM/LOCS(115),STABLE(115)
      DATA (STABLE(I),I=1,115)/
     *6HBTAB01,6HWTAB01,6HWTAB02,6HWTAB03,6HTTAB01,6HTTAB02,6HTTAB10,
     *6HTTAB11,6HCTAB01,6HCTAB02,6HCTAB03,6HCTAB04,6HCTAB05,6HCTAB06,
     *6HFTAB01,6HFTAB02,6HFTAB03,6HVTAB01,
     *6HVTAB02,6HVTAB03,6HVTAB04,6HVTAB05,6HVTAB06,6HVTAB07,6HVTAB08,
     *6HVTAB09,6HVTAB10,6HVTAB11,6HVTAB12,6HVTAB13,6HVTAB14,6HVTAB15,
     *6HVTAB16,            6HVTAB17,6HVTAB18,6HATAB01,6HATAB02,6HATAB03,
     *6HATAB04,6HATAB05,6HATAB06,6HATAB07,6HATAB08,6HATAB09,6HATAB10,
     *6HATAB11,6HATAB12,6HATAB13,6HATAB14,6HATAB15,6HATAB16,6HATAB17,
     *6HATAB18,6HATAB19,6HATAB20,6HATAB21,6HATAB22,6HATAB23,6HATAB24,
     *6HATAB25,6HATAB26,6HATAB27,6HATAB28,6HATAB29,6HATAB30,6HATAB31,
     *6HATAB32,6HATAB33,6HATAB34,6HATAB35,6HATAB36,6HATAB37,6HATAB38,
     *6HATAB39,6HATAB40,6HATAB41,6HATAB42,6HATAB43,6HATAB44,6HATAB45,
     *6HATAB46,6HATAB47,6HATAB48,6HATAB49,6HATAB50,6HATAB51,6HATAB52,
     *6HATAB53,6HATAB54,6HATAB55,6HATAB56,6HATAB57,6HATAB58,6HATAB59,
     *6HATAB60,6HATAB61,6HATAB62,6HATAB63,6HATAB64,6HATAB65,6HATAB66,
     *6HATAB67,6HATAB68,6HATAB69,6HATAB70,6HATAB71,6HATAB72,6HATAB73,
     *6HATAB74,6HATAB75,6HATAB76,6HATAB77,6HATAB78,6HATAB80,6H      /
      END
      SUBROUTINE TSRCH(SYM2,LOC2,N2,IER)
      COMMON/TABCOM/LOCS(115),STABLE(115)

      INTEGER LOC2(N2)
```

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```
      DATA MAXT/115/
      DO 1000 I=1,MAXT
      IF (SYM2 .NE. STABLE(I) ) GO TO 1000
      JM=I
      DO 500 J=1,N2
      LOC2(J) = LOCS(JM)
  500 JM=JM+1
      IER = -1
      RETURN
 1000 CONTINUE
      IER = 1
      RETURN
      END
      SUBROUTINE ASRCH(LOC1,SYM1)
      COMMON/TABCOM/LOCS(115),STABLE(115)
      DATA BLANK,MAXT/1H ,115/
      DO 2000 I=1,MAXT
      IF (LOC1 .NE. LOCS(I)) GO TO 2000
      SYM1 = STABLE(I)
      RETURN
 2000 CONTINUE
      SYM1 = BLANK
      RETURN
      END
      SUBROUTINE DEF
C                  TITLE PRINT POUTINE
      COMMON /DIRCOM/ D1(543) , INDSDF , D2(19) , LONG , NCASE , NPAGE ,
     *NSTAGE,D3(1224),D4(2468)
  900 FORMAT(1H1,36X,40HSIX DEGREES OF FREEDOM FLIGHT PATH STUDY/
     *1H ,42X,28HGENERALIZED COMPUTER PROGRAM/
     *1H0,28X,7HINDSDF I2,5X,5HCASE A6,7X,
     36HSTAGE I2,5X,5HPAGE I6/1H )
      NPAGE=NPAGE+1
      LONG=0
      WRITE(6,900)INDSDF,NCASE,NSTAGE,NPAGE
      RETURN
      END
      SUBROUTINE STFL(JOPT,N,ARG1)
C        GENERAL PRINT ROUTINE
      LOGICAL CLEAN,INTEG
      COMMON/CLEAUP/I2,CLEAN,INTEG
      COMMON/STORA/ARG(48),ALIST(8),GETARG(8),NENT,LENT,K
      DIMENSION ARG1(1)
      IF(JOPT.EQ.0)GO TO 5
      IF(JOPT.EQ.3)GO TO 6
      DO 4 I=1,N
    4 ARG(I)=ARG1(I)
    5 IF(JOPT-1)1,2,3
    1 NENT=1
      IF(I2.EQ.1)RETURN
      CLEAN=.TRUE.
      CALL ARRAY(N,1)
      RETURN
C
    2 NENT=2
      K=1
      CALL ARRAY(N,0)
      RETURN
C
    3 NENT=4
      K=1
      CALL ARRAY(N,0)
      RETURN
    6 GETARG(1)=ARG1(1)
      NENT=5
```

```
      K=2
      CALL ARRAY(N,0)
      RETURN
      END
      BLOCK DATA STFLD
      COMMON/CLEAUP/I2,CLEAN,INTEG
      LOGICAL CLEAN,INTEG
      DATA I2,CLEAN,INTEG/0,.TRUE.,.FALSE./
      END
      SUBROUTINE STOVAR(N,A,B,C,D,E,F,G,H)
      COMMON/STORA/ARG(48),ALIST(8),GETARG(8),NENT,LENT,K
      IF(IABS(N).LE.2)GO TO 2
      IF(IABS(N).LE.4)GO TO 1
      GETARG(8)=H
      GETARG(7)=G
      GETARG(6)=F
      GETARG(5)=E
    1 GETARG(4)=D
      GETARG(3)=C
    2 GETARG(2)=B
      GETARG(1)=A
      NENT=2
      K=2
      CALL ARRAY(N,0)
      RETURN
      END
      SUBROUTINE ARRAY(N,IOPT)
      LOGICAL CLEAN,INTEG
      COMMON/CLEAUP/I2,CLEAN,INTEG
      COMMON/STORA/ARG(48),ALIST(8),GETARG(8),NENT,LENT,K
  705 FORMAT(5X,I8,7I15)
  710 FORMAT(7X,A6,7(9X,A6))
  715 FORMAT(1X,8(1PE15.7))
  720 FORMAT(1H )
      IF(IOPT.NE.0)GO TO 2000
      IF(NENT.EQ.LENT)GO TO 1010
      IF(I2.EQ.0)GO TO 1005
      CLEAN=.TRUE.
      GO TO 2000
 1005 CALL LINES (1)
      WRITE (6,720)
      IF (NENT.EQ.1) RETURN
 1010 INTEG = (N.LT.0)
      NMAX=IABS(N)
      LENT=NENT
      J=1
      GO TO 500
C
C     CLEAN OUT ARRAY
 2000 CALL LINES (1)
      IF (LENT.GE.4) GO TO 2010
      IF (INTEG)        GO TO 2005
      WRITE (6,715) (ALIST(I),I=1,I2)
      GO TO 2020
 2005 WRITE (6,705) (ALIST(I),I=1,I2)
      GO TO 2020
 2010 WRITE (6,710) (ALIST(I),I=1,I2)
 2020 I2=0
      IF ( .NOT.CLEAN) GO TO 500
      CLEAN=.FALSE.
      GO TO 1005
C
C     DEVELOP ARRAY
C
  501 ALIST (I2) = GETARG (J)
```

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      GO TO 520
510   ALIST (I2) = ARG     (J)
520   J=J+1
      IF (I2 .EQ. 8) GO TO 2000
500   IF (J.GT.NMAX) RETURN
      I2=I2+1
      GO TO (510,501),K
      END
      SUBROUTINE LINES(LCOUNT)
C                 LINES ACCOUNTING ROUTINE
      COMMON /DIRCOM/D1(663),LONG,D2(1227),D3(2068)
      LONG=LONG+LCOUNT
      IF(LONG.LE.51)RETURN
      CALL DLF
      LONG=LCOUNT
      RETURN
      END
      FUNCTION ASIN(X)
      EXTERNAL ACOS
      ASIN=1.570963-ACOS(X)
      RETURN
      END
      FUNCTION ACOS(X)
      IF (ABS(X) .GT. 1.0) GO TO 100
      IF (ABS(X).GT. 7.4505806E-09) GO TO 50
      ACOS=1.570963
      RETURN
50    IF (X .NE. 1.) GO TO 40
      ACOS=0.
      RETURN
40    IF (X .NE. (-1.)) GO TO 30
      ACOS=3.1415926
      RETURN
30    A=0.
      X1=X
      DO 20 I=1,27
      IF (X1 .GT. 0.)GO TO 10
      SA=1.
      X2=1.-(2.*X1**2)
      GO TO 5
10    SA=0.
      X2=(2.*X1**2)-1.
5     A=A+SA*2.**(-(I-1)-1)
20    X1=X2
      ACOS=3.1415926*A
      RETURN
 100  WRITE (6,200)X
 200  FORMAT(26H0ARGUMENT OUT OF RANGE X =E20.8)
      ACOS=99999999.
      RETURN
      END
      FUNCTION ATAN2 (Y,X)
C     ***************************************************
C     SINGLE PRECISION FORTRAN ARCTANGENT FUNCTION SUBROUTINE
C     NOTE. ------- ZERO ARGUMENTS WILL EXIT WITH ZERO ANSWER
C     ***************************************************
      LOGICAL INDIC
      REAL L
      DIMENSION AA(6),A(4),B(4),PN(4)
      DATA   (AA(I), I = 1,6)   /
C     MIN IS AA(1), MAX IS AA(6)
     *    .180264515E-8, .176326981E+0, .577350269E+0, .119175359E+1,
     2    .274747742E+1, .134217728E+9  /
      DATA   (A(I), I = 1,4)   /
     *    .449587214E+0, .195014224E+0, .944754986E-1, .288535059E-1  /
```

```
      DATA  (B(I), I = 1,4)  /
     *    .139885708E+1, .396745266E+0, .218181818E+0, .168724015E+0  /
      DATA  (PN(I), I = 1,4)  /
     *    .349065850E+0, .698131701E+0, .104719755E+1, .139626340E+1  /
      DATA C1, C2, C3, L  /
     *    .511134596E-1, .270998425E-2, .216649136E+0, .163636364E+0  /
      DATA   PIOV2, ONEPI   /
     *    .157079633E+1, .314159265E+1   /
      IF (Y .EQ. 0.0)  GO TO 16
      IF (X .EQ. 0.0)  GO TO 15
      INDIC = (X .LT. 0.0)
C     INDIC = .TRUE., ANGLE IS IN QUADRANT 1 OR 4
      R = Y/X
    9 Z = ABS(R)
      DO 10  I = 1,6
      IF (Z-AA(I) .LT. 0.0)   GO TO (18,12,11,11,11,11),I
   10 CONTINUE
      GO TO 17
   11 I = I - 2
      J = 6 - I
      P = PN(I)
      Z = A(I) - B(I)/(Z + AA(J))
      GO TO 13
   12 Z = Z*L
      J = 5 - I
      P = 0.0
   13 T = Z**2 + C3 - C2/((Z**2) + C1)
      ATAN2 = Z/T + P
   14 ATAN2 = SIGN(ATAN2,R)
   19 IF ( .NOT. INDIC)  RETURN
      IF (ATAN2 .GT. 0.0)   GO TO 23
      ATAN2 = ATAN2 + ONEPI
      RETURN
   15 ATAN2 = SIGN(PIOV2,Y)
      RETURN
   16 IF (X .GE. 0.0)  GO TO 22
      ATAN2 = ONEPI
      RETURN
   17 ATAN2 = PIOV2
      GO TO 14
   18 ATAN2 = R
      GO TO 19
   22 ATAN2 = 0.0
      RETURN
   23 ATAN2 = ATAN2 - ONEPI
      RETURN
      END
      SUBROUTINE ERROR(LOCT)
C                GENERAL TABLE ERROR ROUTINE
      COMMON /DIRCOM/ DM(5) , SH(641) , INDSTE , DM1(1244),DM2(2068)
      DATA IBL / 1H  /
      INDSTE=0
      CALL LINES (2)
      CALL ASRCH(LOCT,NAME)
      IF (NAME .EQ. IBL) GO TO 5
      WRITE (6,1) NAME
      RETURN
    5 WRITE (6,2)
    1 FORMAT (14H0TABLE ERROR   ,A6)
    2 FORMAT (12H0TABLE ERROR/1H ,47H...LOCATION OF TABLE NOT LISTED IN
     1DIRECTORY...)
      RETURN
      END
      SUBROUTINE EXERR(NUM)
      COMMON/DIRCOM/DM(5),SH(641),INDSTE,DM1(1244),DM2(2068)
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      INOSTE = 0
      IF (NUM .EQ. 0) RETURN
      CALL STFL(0,1,DU)
      CALL LINES (3)
      WRITE (6,3) NUM
 3    FORMAT (1HA,15X,12HSTOF NUMBER I3)
      RETURN
      END
      SUBROUTINE NDTLU (ND,NA,X,Z,XA,ZR,IE)
C                N-DIMENSION TABLE LOOK-UP ROUTINE
C                                     ND     DIM. OF LOOK-UP
C                                     NA     NUMBERS OF VALUES OF EACH TABLE
C                                     X      TABLES OF EACH X IN ORDER
C                                     Z     FUNCTION VALUES
C                                     XA     ARRAY OF ARGUMENTS
C                                     ZR     RESULT
C                                     IE     ERROR RETURN
C                                        0   NO ERROR
C                                       -1   X ARRAY TO SMALL
C                                        1   X ARRAY TO LARGE
C                                        2   ARRAY NOT ASCENDING ORDER
C   WJ(2**MAX(N))
      DIMENSION X(1),Z(1),NA(1),XA(1),NS(8),WJ( 32)
      IE=0
      L1=2
      LF=ND-1
      DO 3 I=1,LF
      L2=L1+NA(I)-2
      FIND=0.
      DO 4 J=L1,L2
      IF(X(J).GT.X(J-1)) GO TO 6
      IE=2
      RETURN
 6    IF(FIND.NE.0.) GO TO 4
      IF (XA(I)-X(J-1)) 8,4,4
 8    IF (J.GT.L1) GO TO 1J
      IE=-1
      RETURN
 10   FIND=1.
      NS(I)=J-2
 4    CONTINUE
      IF (FIND) 11,12,11
 12   IF (XA(I)-X(L2)) 13,13,14
 14   IE=1
      RETURN
 13   NS(I)=L2-1
 11   L1=L2+2
 3    CONTINUE
      KF=2**LF
      MW=-2
      DO 18 I=1,KF,2
      L1=0
      IZ=0
      MW=MW+2
      NPT=1
      DO 19 J=1,LF
      MM=2**(J-1)
      IF(AND(MM,MW).EQ.0)GO TO 22
      N=NS(J)+1
      GO TO 23
 22   N=NS(J)
 23   N=N-L1
      L1=L1+NA(J)
      IZ=NPT*(N-1)+IZ
      NPT=NPT*NA(J)
```

```
      WJ(I)=Z(IZ+1)
 18   WJ(I+1)=Z(IZ+2)
      L1=1
      DO 32 I=1,LF
      M=NS(I)
      PER=(XA(I)-X(M))/(X(M+1)-X(M))
      JF=KF/2
      DO 32 J=1,JF
 32   WJ(J)=WJ(2*J-1)+(WJ(2*J)-WJ(2*J-1))*PER
      ZR=WJ(1)
      RETURN
      END
      SUBROUTINE ATMS (HGC7F)
C                ATMOSPHERE CALCULATION ROUTINE
      LOGICAL HGT90,EVEN
      DIMENSION HB(11),RHOB(11),PB(11),TB(11),AK1(11),AK2(11),AK3(11),
     1A(2),B(2),C(2),D(2)
      COMMON /DIRCOM/
     1DM(259)     ,ANUA7F     ,DM1(324)   ,INDATM     ,DM2(192)   ,PA77P      ,
     2DM3(95)     ,RHOAS      ,DM4(89)    ,TA77R      ,DM5(80)    ,VS77F      ,
     3DM6(940),DM7(2068)
C
C          ALTITUDE,    DENSITY , PRESSURE   ,TEMPERATURE,          /
      DATA (HB(I),I=1,11)/0.,1.1E4,2.5E4,4.7E4,5.3E4,7.9E4,
     C9.E4,10.5E4,16.E4,17.E4,2.E5/
      DATA (RHOB(I),I=1,11)/23.7692E-4,7.062E-4,7.765E-5,
     C2.8824E-5,13.9468E-7,4.1189E-8,4.2610E-9,2.232E-10,
     C1.845E-12,1.338E-12,6.113E-13/
      DATA (PB(I),I=1,11)/2116.21695,472.73,51.979,2.5155,
     C1.2181,2.108E-2,21.809E-4,15.562E-5,75.578E-7,
     C58.954E-7,29.759E-7/
      DATA (TB(I),I=1,11)/518.688,389.988,389.988,508.788,
     C508.188,298.188,298.188,406.188,2386.188,
     C2566.188,2836.188/
      DATA (AK1(I),I=1,11)/-.225569E-4,0.,.138466E-4,0.,
     C-.159202E-4,0.,.241458E-4,.886289E-4,.754341E-5,
     C.330715E-5,.222129E-5/
      DATA(AK2(I),I=1,11)/-5.25612,0.,11.3883,0.,-7.59218,
     C0.,8.5412,1.72824,3.41648,6.83296,9.76137/
      DATA(AK3(I),I=1,11)/0.,.157689E-3,0.,.120869E-3,
     C0.,.200234E-3,5*0./
      DATA A(1),A(2),B(1),B(2),C(1),C(2),D(1),D(2)/.759511,.935787,
     C.174164,.273966,220.,180.,25.,140./
C
      IF ((INDATM.EQ.0).OR.(HGC7F.GE.2.5E6)) GO TO 470
      IF (HGC7F.LE.0.) GO TO 460
      TMP=.3049*HGC7F
      HGP=TMP/(1.+TMP/6356766.)
      HGT90=.TRUE.
      M=2
      IF (HGP.GT.180000.) GO TO 49
      M=1
      IF (HGP.GT.90000.) GO TO 49
      HGT90=.FALSE.
C  SEARCH FOR   LAYER
 49   IF (HGP.LT.HB(11)) GO TO 50
      LAY=11
      GO TO 60
 50   DO 55 I=2,11
      IF (HGP.GT.HB(I)) GO TO 55
      LAY=I-1
      GO TO 60
 55   CONTINUE
 60   TMP=HGP-HB(LAY)
      TMP2=1.+AK1(LAY)*TMP
```

```
      IF (LAY.GT.6) GO TO 69
      IF (2*(LAY/2).NE.LAY) GO TO 69
      EVEN=.TRUE.
      GO TO 70
69    EVEN=.FALSE.
70    TA77R= TB(LAY)*TMP2
      IF (EVEN) GO TO 72
      PA77P=PB(LAY)*TMP2**(-AK2(LAY))
      RHOAS=RHOB(LAY)*TMP2**(-1.-AK2(LAY))
      GO TO 80
72    TMP3=EXP(-AK3(LAY)*THP)
      PA77P=PB(LAY)*TMP3
      RHOAS=RHOB(LAY)*TMP3
80    IF (HGT9.) GO TO 85
      STA77R=SQRT(TA77R)
      VS77F= 49.022576*STA77R
      ANUA7F=.0226988E-6*(TA77R*STA77R/((TA77R+198.72)*RHOAS))
      RETURN
85    VS77F=0.
      ANUA7F=0.
      TA77R=TA77R*(A(M)-B(M)*ATAN(HGP-C(M)/D(M)))
      RETURN
460   VS77F=1116.43372
      TA77R=TB(1)
      PA77P=PB(1)
      ANUA7F=1.5723288E-4
      RHOAS=RHOB(1)
      RETURN
470   VS77F=0.
      TA77R=0.
      PA77P=0.
      ANUA7F=0.
      RHOAS=0.
      RETURN
      END
      SUBROUTINE INVR3(A,B,INDER)
C                A 3 X 3 MATRIX INVERSION ROUTINE
      DIMENSION A(3,3),B(3,3)
      B(1,1)=A(2,2)*A(3,3)-A(2,3)*A(3,2)
      D=B(1,1)*A(1,1)
      B(1,2)=A(3,2)*A(1,3)-A(1,2)*A(3,3)
      D=D+B(1,2)*A(2,1)
      B(1,3)=A(1,2)*A(2,3)-A(2,2)*A(1,3)
      D=D+B(1,3)*A(3,1)
      IF(ABS(D).LE.1.E-18)GO TO 19
      B(2,1)=A(3,1)*A(2,3)-A(3,3)*A(2,1)
      B(2,2)=A(1,1)*A(3,3)-A(3,1)*A(1,3)
      B(2,3)=A(2,1)*A(1,3)-A(1,1)*A(2,3)
      B(3,1)=A(2,1)*A(3,2)-A(3,1)*A(2,2)
      B(3,2)=A(3,1)*A(1,2)-A(1,1)*A(3,2)
      B(3,3)=A(1,1)*A(2,2)-A(1,2)*A(2,1)
      DO 17 J=1,3
      DO 17 I=1,3
17    B(I,J)=B(I,J)/D
      INDER=1
      RETURN
19    INDER=2
      RETURN
      END
      SUBROUTINE MULT31 (A,B,C)
C                A MATRIX MULTIPLICATION ROUTINE
      DIMENSION A(3,3),B(3),C(3)
      DO 1 I=1,3
      C(I)=0.
      DO 1 J=1,3
```

```
      C(I)=C(I)+A(I,J)*B(J)
      RETURN
      END
      SUBROUTINE MULT33(A,B,C)
C               A MATRIX MULTIPLICATION ROUTINE
      DIMENSION A(3,3),B(3,3),C(3,3)
      DO 1 I=1,3
      DO 1 J=1,3
      C(I,J)=0.
      DO 1 K=1,3
 1    C(I,J)=C(I,J)+A(I,K)*B(K,J)
      RETURN
      END
      SUBROUTINE TRNPOS (A,B)
C               A 3 X 3 MATRIX TRANSPOSE ROUTINE
      DIMENSION A(3,3),B(3,3)
      DO 1I=1,3
      DO 1J=1,3
 1    B(I,J)=A(J,I)
      RETURN
      END
      SUBROUTINE MIMC(N,LOCT,NX1,NX2,NX3,NX4,X1ARG,X2ARG,
     *X3ARG,X4ARG,A)
C               TABLE SETUP ROUTINE
      COMMON/TABUIP/TABLE(1)
      DIMENSION XA(4),NA(4)
 11   FORMAT (1H0,15X,40HAN ARGUMENT EXCEEDS LOWER LIMIT OF TABLE)
 12   FORMAT (1H0,15X,40HAN ARGUMENT EXCEEDS UPPER LIMIT OF TABLE)
 16   FORMAT (1H0,15X,44HINDEPENDENT VARIABLES NOT IN ASCENDING ORDER)
      XA(1)=X1ARG
      XA(2)=X2ARG
      XA(3)=X3ARG
      XA(4)=X4ARG
      NA(1)=NX1
      NA(2)=NX2
      NA(3)=NX3
      NA(4)=NX4
      NAT=NX1
      IF (N-4) 3,4,5
 3    NAT=NAT+NA(2)
      GO TO 6
 4    NAT=NAT+NA(2)+NA(3)
      GO TO 6
 5    NAT=NAT+NA(2)+NA(3)+NA(4)
 6    II=NAT+LOCT
      CALL NDTLU(N,NA,TABLE(LOCT),TABLE(II),XA,A,IERROR)
      IF (IERROR.EQ.0) RETURN
      CALL STFL(0,1,DUM)
      CALL ERROR(LOCT)
      CALL LINES (2)
      IF (IERROR-1) 7,14,15
 7    WRITE (6,11)
 13   RETURN
 14   WRITE (6,12)
      RETURN
 15   WRITE (6,16)
      RETURN
      END
      SUBROUTINE TLU(X,LOCT,Y)
C               TWO DIMENSIONAL TABLE LOOK-UP ROUTINE
      COMMON/TABUIK/C(1)
      EQUIVALENCE (N,Z)
      LOCTM1=LOCT-1
      N=0
      Z=C(LOCT)
```

```
      DO 1 I=1,N
      J=2*I+LOCTM1
      IF(C(J)-X) 1,6,2
 1    CONTINUE
      GO TO 5
 2    IF(J.GT.(LOCTM1+2))GO TO 4
      J=3+LOCTM1
 5    CALL ERROR(LOCT)
 4    Y=C(J-1)+(C(J+1)-C(J-1))*(X-C(J-2))/(C(J)-C(J-2))
      RETURN
 6    Y=C(J+1)
      RETURN
      END
      SUBROUTINE TFFS1
C
C         ENGINE THRUST
C
C        INPUT REQUIRED (FROM DIRCOM)
C     ALT77F, AMACH, AMASS, AMASS1, AMASZS, AMT77F,
C     ANT77F, INDTFF, TXB7P, TYB7P, TZB7P, IN, N(5)
C     IT10W, IT10X, ZN(5), YN(5)
C
      COMMON/DIRCOM/DM1(126),ALT77F,DM2(6),AMACH,DM3(2),
     *AMASS,AMASS1,AMASZS,DM4(5),AMT77F,DM5(13),ANT77F,
     *DM6(495),INDTFF,DM7(296),TXB7P,DM8(2),TYB7P,DM9(2),
     *TZB7P,DM10(2),IT10W,IT10X,DM11(2),IT11W,IT11X,DM12(221),
     *AMASFS(2),AMASF1(2),DM13(444),IN,ZN(5),YN(5),N(5),DM14(290),
     *DM15(2068)
C
C
C     IN     - NUMBER OF ENGINES
C     N(I)   - THROTTLE POSITION FOR I ENGINE
C     YN(I)  - ENGINE POSITIAN FOR I ENGINE
C     ZN(I)  - ENGINE POSITIAN FOR I ENGINE
C     MT(I)  - ENGINE PITCH MOMENT FOR I ENGINE
C     NT(I)  - ENGINE YAW MOMENT FOR I ENGINE
C     T(I)   - ACTUAL ENGINE THROUST FOR I ENGINE
C
      DIMENSION S(2)
      COMMON/FLXUP/DM1(300),T(5),DM2(303)
      COMMON/TABSPC/LOC(2),DUMM1(108)
      REAL N,MT(5),NT(5)
      DATA FMT1/6H  TFFS/,
     CS(1),S(2)/2HMT,2HNT/
C
C     INITIALIZATION BEFORE DATA READ IN
C
      TXB7P=0.
      TYB7P=0.
      TZB7P=0.
      ALT77F=0.
      AMT77F=0.
      ANT77F=0.
      RETURN
C
C     THRUST COMPUTATION SECTION
C
      ENTRY TFFS3
      TXB7P=0.
      TYB7P=0.
      TZB7P=0.
      ALT77F=0.
      AMT77F=0.
      ANT77F=0.
      IF(INDTFF.EQ.0)RETURN
```

```
      DO 10 I=1,IN
      CALL HIRO(3,LCC(1),IT10H,IT10X,DU,DU,N(I),AMACH,
     CDU,  ,T(I))
      MT(I)=T(I)*ZN(I)
      NT(I)=-T(I)*YN(I)
      TX87P=TX87P+T(I)
      AMT77F=AMT77F+MT(I)
      ANT77F=ANT77F+NT(I)
 10   CONTINUE
      RETURN
C
C     INITIAL PRINT
C
      ENTRY TFFS4
      RETURN
C
C     COMPUTE AND PRINT CODES
C
      ENTRY TFFS5
      IF(INOTFF.EQ.0)RETURN
      CALL STFL(3,1,FMT1)
      CALL STFL(2,2,S)
      RETURN
C
C     TIME HISTORY PRINT
C
      ENTRY TFFS6
      IF(INOTFF.EQ.0)RETURN
      CALL STFL(3,1,FMT1)
      CALL STOVAR(2,AMT77F,ANT77F,DU,DU,DU,DU,DU,DU)
      CALL STFL(0,1,DU)
      CALL LINES(2)
      WRITE(6,60) (T(I),I=1,IN)
 60   FORMAT(1H0,63X,4HT(I)/(14X,5E20.8))
      RETURN
C
C     UPDATE INTEGRATION
C
      ENTRY TFFS7
      RETURN
      END
      SUBROUTINE TFFS8(TC,TN)
C
C     SEARCH THROUGH RANGES OF N TO FIND THE N
C     THAT CORRESPONDS WITH THRUST TC AND CURRENT
C     MACH NUMBER
C
C     INPUT - TC (THRUST) AND MACH (CURRENT AMACH NO.)
C     OUTUT - TN (THROTTLE SETTING)
C
      COMMON/DIRCOM/DM1(226),ALT77F,DM2(6),AMACH,DM3(2),
     *AMASS,AMASS1,AMASZS,DM4(5),AMT77F,DM5(13),ANT77F,
     *DM6(495),INOTFF,DM7(246),TX87P,DM8(2),TY87P,DM9(2),
     *TZ87P,DM10(2),IT10W,IT10X,DM11(2),IT11W,IT11X,DM12(221),
     *AMASFS(2),AMASF1(2),DM13(444),IN,ZN(5),YN(5),N(5),DM14(290),
     *DM15(2068)
C
      COMMON/TABDIR/C(1)
      COMMON/TABSRC/LOC(2),DUMM1(100)
C
      IF(INOTFF.NE.0)GO TO 26
      TN=0.
      RETURN
 26   LOCT=LOC(1)-1
      DO 20 I=1,IT10W
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```
      K=LOCT+I
      CALL HIHO(3,LOC(1),IT10W,IT10X,DU,DU,C(K),AMACH,DU,DU,TH2)
      IF(C(K).GT.(-2.))GO TO 21
      IF(TC.GT.TH2)GO TO 19
      TN=-2.
      RETURN
   21 IF(C(K).GT.(-1.))GO TO 22
      IF(TC.GT.TH2)GO TO 19
   25 TN=C(K-1)+(TH1-TC)*(C(K)-C(K-1))/(TH1-TH2)
      RETURN
   22 IF(C(K).EQ.1.)GO TO 27
      IF(C(K).GT.1.)GO TO 23
      IF(TC.GT.TH2)GO TO 19
      TN=-1.
      RETURN
   27 IF(TC.GT.TH2)GO TO 19
      TN=1.
      RETURN
   23 IF(C(K).GT.2.)GO TO 24
      IF(TC.GT.TH2)GO TO 19
      GO TO 25
   24 TN=2.
      RETURN
   19 TH1=TH2
   20 CONTINUE
      RETURN
      END
      SUBROUTINE TFF39(THRSET,THRUST)
C
C     COMPUTE THRUST AS A FUNCTION OF CURRENT MACH NO.,
C     AND DESIGNATED THROTTLE SETTING
C
C     INPUT  - THRSET(THROTTLE SETTING)
C     INPUT  - AMACH(MACH NO. FROM DIRCOM)
C     OUTPUT - THRUST
C
      COMMON/DIRCOM/DM1(126),ALT77F,DM2(6),AMACH,DM3(2),
     *AMASS,AMASS1,AMASZS,DM4(5),AMT77F,DM5(13),ANT77F,
     *DM6(495),INOTFF,DM7(246),TXB7P,DM8(2),TYB7P,DM9(2),
     *TZB7P,DM10(2),IT10W,IT10X,DM11(2),IT11W,IT11X,DM12(221),
     *AMASFS(2),AMASF1(2),DM13(444),IN,ZN(5),YN(5),N(5),DM14(290),
     *DM15(2068)
C
      COMMON/TABSRC/LOC(2),DUMM1(168)
C
      IF(INOTFF.NE.0)GO TO 30
      THRUST=0.
      RETURN
   30 CALL HIHO(3,LOC(1),IT10W,IT10X,DU,DU,THRSET,AMACH,
     CDU,DU,THRUST)
      RETURN
      END
      SUBROUTINE VPCS1
C           VEHICLE PHYSICAL CHARACTERISTICS
      DIMENSION A(4)
      COMMON /DIRCOM/
     1DM(29)          ,
     2AIXXBS         ,AIXXS1        ,AIXYBS        ,AIXYS1        ,AIXZBS        ,AIXZS1        ,
     3DM1            ,AIYYBS        ,AIYYS1        ,AIYZBS        ,AIYZS1        ,DM2           ,
     4AIZZBS         ,AIZZS1        ,DM3(68)       ,
     5ALLJOF         ,ALMJOF        ,DM4(2)        ,              ALNJOF         ,DM5(11)       ,
     6ALYJOF         ,ALZJOF        ,DM6(7)        ,
     7AMASS          ,DM7(25)       ,
     8AREFF          ,DM8(187)      ,
     9DXCGF          ,DM9(5)        ,
```

```
      1D1RFF      ,DM1         ,D2RFF       ,DM11(15)    ,EPS21       ,EPS22       ,
      2EPS18      ,EPS19       ,DM12        ,EPS20
      3EPS23      ,EPS24       ,DM13(215)   ,
      4INDIDT     ,DM14(3)     ,                                      INDJDP       ,
      5DM15(53)   ,
      6INDTSO     ,INDVPC      ,DM16(2)     ,              INDXYS     ,INDXZS      ,
      7DM17(223)  ,
      8TIMEC      ,DM18(74)    ,
      9XCGBF      ,XCGRF       ,DM19( 930),DM20(2068)
       COMMON/TABSPC/DUMM1(81),LOC(18),DUMM2(11)
       EQUIVALENCE (BS1IXX,AIXXS1),(BS1IYY,AIYYS1),(BS1IZZ,AIZZS1),
      *(BS1IXY,AIXYS1),(BS1IXZ,AIXZS1),(BS1IYZ,AIYZS1)
       DATA
      1(A(I),I=1,4)/5HXCGRF,5HAREFF,5HD1RFF,5HD2RFF/,
      2D,HDCI/5HAMASS,6H  VPCS/
 2     FORMAT (1H0,15X,26HINITIAL PRINT OUT FOR VPCS)
       RETURN
C      ******************************
C      INITIALIZATION AFTER DATA READ IN
       ENTRY VPCS2
       IF (INDVPC .EQ. 0) RETURN
C      ******************************
 173   BS1IXX=0.
       BS1IYY=0.
       BS1IZZ=0.
       BS1IXY=0.
       BS1IXZ=0.
       BS1IYZ=0.
       ALLJDF=0.
       ALHJDF=0.
       ALNJDF=0.
       ALYJDF=0.
       ALZJDF=0.
       IF (INDXZS.EQ.0) GO TO 212
       AIXYBS=0.
       AIYZBS=0.
 212   IF (INDXYS.NE. ) AIXZBS=0.
       RETURN
C      ***********************************************
C      VEHICLE PHYSICAL CHARACTERISTICS SUBPROGRAM SECTION
C      ***********************************************
       ENTRY VPCS3
       IF (INDVPC .EQ. 0) RETURN
C      ***********************************************
 216   IF (INDTSO.EQ.0) GO TO 451
 223   CALL TLU(AMASS,LOC(1),XCGBF)
       CALL TLU(AMASS,LOC(2),AIXXBS)
       CALL TLU(AMASS,LOC(3),AIYYBS)
       CALL TLU(AMASS,LOC(4),AIZZBS)
       XCGBF=XCGBF+EPS18
       AIXXBS=AIXXBS+EPS19
       AIYYBS=AIYYBS+EPS20
       AIZZBS=AIZZBS+EPS21
       IF (INDXZS.NE.0) GO TO 335
       CALL TLU(AMASS,LOC(5),AIXYBS)
       CALL TLU(AMASS,LOC(7),AIYZBS)
       AIXYBS=AIXYBS+EPS22
       AIYZBS=AIYZBS+EPS24
 335   IF (INDXYS.NE.0) GO TO 353
       CALL TLU(AMASS,LOC(6),AIXZBS)
       AIXZBS=AIXZBS+EPS23
 353   IF (INDJDP.EQ.0) GO TO 451
       CALL TLU(XCGBF,LOC(8),ALYJDF)
       CALL TLU(XCGBF,LOC(9),ALZJDF)
       CALL TLU(XCGBF,LOC(10),ALLJDF)
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      CALL TLU(XCGBF,LOC(11),ALMJBF)
      CALL TLU(XCGBF,LOC(12),ALNJBF)
  451 IF (INDIDT.EQ.0) GO TO 567
      CALL TLU(TIMES,LOC(13),BS1IXX)
      CALL TLU(TIMES,LOC(14),BS1IYY)
      CALL TLU(TIMES,LOC(15),BS1IZZ)
  503 IF (INDXZS.NE.0) GO TO 551
      CALL TLU(TIMES,LOC(16),BS1IXY)
      CALL TLU(TIMES,LOC(18),BS1IYZ)
  551 IF (INDXYS.NE.0) GO TO 567
      CALL TLU(TIMES,LOC(17),BS1IXZ)
  567 DXCGF=XCGBF-XCGRF
      RETURN
C     *************
C     INITIAL PRINT
      ENTRY VPCS4
      IF (INDVPC .EQ. 0) RETURN
C     *************
   27 CALL STFL(0,1,DU)
      WRITE (6,2)
      CALL STFL(2,4,A)
      CALL STOVAR(4,XCGRF,AREFF,D1RFF,D2RFF,DU,DU,DU,DU)
      RETURN
C     ************************
C     COMPUTE AND PRINT CODES
      ENTRY VPCS5
      IF (INDVPC .EQ. 0) RETURN
C     ************************
   64 CALL STFL(3,1,HBCI)
      CALL STFL(2,1,0)
      RETURN
C     *****************
C     TIME HISTORY PRINT
      ENTRY VPCS6
      IF (INDVPC .EQ. 0) RETURN
C     *****************
  103 CALL STFL(3,1,HBCI)
      CALL STFL(1,1,AMASS)
      RETURN
C     **********
      ENTRY VPCS7
C     **********
      RETURN
      END
      SUBROUTINE SACS1
      EXTERNAL ASIN
C                 AERODYNAMIC FORCES AND MOMENTS
      LOGICAL INDARC
      DIMENSION B(3),D(3),TMP(20),INC(79),TC(79)
      COMMON /DIRCCM/
     1DM(22)      ,
     2AA77P       ,DM1(81)      ,
     3ALA77F      ,DM2(3)       ,                 ALIFTP      ,DM3(7)       ,
     4ALPHD,DM4(3),ALPHR1,DM5(3),
     5ALPTD       ,DM6(8)       ,                              AMA77F       ,
     6AMACH(3)    ,DM7(4)       ,
     7DM8(3),AMT77F,DM56(5),
     8ANAZ7F      ,ANA77P      ,DM9(6)      ,ANT77F,
     9ANUA7F      ,DM10(2)      ,      AREFF       ,DM11(11)     ,
     1BETAD,DM12(3),BETAR1,DM13(22),
     2CA          ,DM14(2)      ,      CAMNU       ,DM15(6)      ,
     3CD          ,DM16(2)      ,      CDMNU       ,DM17(6)     ,CL          ,
     4DM18(3)     ,                    CLMNU       ,CM          ,CMMNU       ,
     5CN2MNU,CN1MNU,DM19,CPHIA,DM20(9),
     6CRM         ,DM21(7)      ,
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     7CY        ,DM22       ,CYM        ,CYMNU      ,DM23(49)
     8DCU1      ,DCV1       ,DCW1       ,DCU2       ,DCV2       ,DCW2       ,
     9DCU3      ,DCV3       ,DCW3       ,DM24(15)
      COMMON /DIRCOM/
     1DELPD     ,DM25       ,DELQD      ,DM26       ,DELRD      ,DM27(17)   ,
     2DRAGP     ,DM28       ,DXCGF      ,DM29(3)    ,
     3DYNPP     ,DM30       ,D1RFF      ,DM31       ,D2RFF      ,DM32(6)    ,
     4EPS1      ,EPS10      ,EPS11      ,EPS12      ,DM33(7)    ,
     5EPS2      ,DM34(7)    ,
     6EPS3      ,EPS4       ,EPS5       ,EPS6       ,EPS7       ,EPS8       ,
     7EPS9      ,DM35(43),HGC7F,DM61(44),
     5INDAER    ,DM37(2)    ,           INDARC      ,DM38(3)
      COMMON /DIRCOM/
     1INDA01    ,INDA02     ,INDA03     ,INDA04     ,INDA05     ,INDA06     ,
     2INDA07    ,INDA08     ,INDA09     ,INDA10     ,INDA11     ,INDA12     ,
     3INDA13    ,INDA14     ,INDA15     ,INDA16     ,INDA17     ,INDA18     ,
     4INDA19    ,INDA20     ,INDA21     ,INDA22     ,INDA23     ,INDA24     ,
     4INDA25    ,INDA26     ,INDA27     ,INDA28     ,INDA29     ,INDA30     ,
     5INDA31    ,INDA32     ,INDA33     ,INDA34     ,INDA35     ,INDA36     ,
     6INDA37    ,INDA38     ,INDA39     ,INDA40     ,INDA41     ,INDA42     ,
     7INDA43    ,INDA44     ,INDA45     ,INDA46     ,INDA47     ,INDA48     ,
     8INDA49    ,INDA50     ,INDA51     ,INDA52     ,INDA53     ,INDA54     ,
     9INDA55    ,INDA56     ,INDA57     ,INDA58     ,INDA59     ,INDA60     ,
     1INDA61    ,INDA62     ,INDA63     ,INDA64     ,INDA65     ,INDA66     ,
     2INDA67    ,INDA68     ,INDA69     ,INDA70     ,INDA71     ,INDA72     ,
     3INDA73    ,INDA74     ,INDA75     ,INDA76     ,INDA77     ,INDA78     ,
     4INDA80    ,DM52(13)   ,INDBAD     ,DM39(7)
      COMMON /DIRCOM/
     7INDFLT    ,DM40(55)   ,
     8INDSDF    ,DM41(23)   ,
     8NSYMD     ,DM42(140)  ,
     9SIDEP     ,DM43(11)   ,
     9SPHIA     ,DM44(111)  ,
     1VA77F,DM45(11),
     2VS77F     ,DM46(35)   ,
     4YA77P     ,DM47(8),YGW7F1,DM59(179),
     5PI77R,DM48(7),
     6QI77R,DM49(7),
     7RI77R,DM50(13),TS77P,DM51(420),IAP,DM57(3),
     *ALPHDS,ALPHDL,FCG,DM53(94),DELQN,DM54(7),
     *DELQL,DELQU,DM55(7),DELRL,DELRU,DM60(78),HP,DM58(64),DDM77(2068)
      COMMON/TABSRC/DUMM1(2),LOC(79),DUMM2(29)
C
      COMMON/AUTSAC/ALPDR1,QDESP,CLRR,ALPDES,CDR,DELRN
C
      COMMON/LG/FXM,FYM,FZM,LM,MM,NM,EPSLO2
      REAL LM,MM,NM
C
      EQUIVALENCE (INDA01,INC(1)),
     *(TC( 1),CAALPH),(TC( 2),CAALSQ),(TC( 3),CABETA),(TC( 4),CABTSQ),
     *(TC( 5),CADLTQ),(TC( 6),CADLSQ),(TC( 7),CAALDT),(TC( 8),CAALDL),
     *(TC( 9),CADTDL),(TC(10),CN1ZER),(TC(11),CN1ALP),(TC(12),CN1ASQ),
     *(TC(13),CN1BET),(TC(14),CN1BSQ),(TC(15),CN1DLQ),(TC(16),CN1DSQ),
     *(TC(17),CN1ALB),(TC(18),CN1ALD),(TC(19),CN1BDL),(TC(20),CN1ADL),
     *(TC(21),CN1ADX),(TC(22),CN1Q  ),(TC(23),CN1QX ),(TC(24),CYZERO),
     *(TC(25),CYALPH),(TC(26),CYALSQ),(TC(27),CYBETA),(TC(28),CYBTSQ),
     *(TC(29),CYDELR),(TC(30),CYDRSQ),(TC(31),CYALBT),(TC(32),CYALDL),
     *(TC(33),CYBTDL),(TC(34),CYBTDT),(TC(35),CYBTDX),(TC(36),CYR   ),
     *(TC(37),CYRX  ),(TC(38),CLZERO),(TC(39),CLALPH),(TC(40),CLALSQ),
     *(TC(41),CLBETA),(TC(42),CLBTSQ),(TC(43),CLDLTP),(TC(44),CLDLSQ),
     *(TC(45),CLALPT),(TC(46),CLALDL),(TC(47),CLBTDL),(TC(48),CLP   ),
     *(TC(49),CLPX  ),(TC(50),CLRX  ),(TC(51),CMZERO),(TC(52),CMALPH),
     *(TC(53),CMALSQ),(TC(54),CMBETA),(TC(55),CMBTSQ),(TC(56),CMDLTQ),
     *(TC(57),CMDLSQ),(TC(58),CMALBT),(TC(59),CMALDL),(TC(60),CMBTDL),
     *(TC(61),CMALDT),(TC(62),CMADTX),(TC(63),CMQ   ),(TC(64),CMQX  ),
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     *(TC(65),CN2ZER),(TC(66),CN2ALP),(TC(67),CN2ASQ),(TC(68),CN2BET),
     *(TC(69),CN2BSQ),(TC(70),CN2DLT),(TC(71),CN2DSQ),(TC(72),CN2ALB)
      EQUIVALENCE
     *(TC(73),CN2ALD),(TC(74),CN2BDL),(TC(75),CN2BTD),(TC(76),CN2BDX),
     *(TC(77),CN2R  ),(TC(78),CN2RX ),(TC(79),CAVAH)
      EQUIVALENCE (CY,CYA),(DYNPL,DYNPP)
      DATA DEGRAD/.01745329/
      DATA
     *HSCI,C/6H  SAC1,6HCAVAH /,
     1(B(I),I=1,3)/2HCA,2HCN,2HCY/,
     2(D(I),I=1,3)/2HCL,2HCM,3HCNN/
 1    FORMAT (1H ,15X,26HINITIAL PRINT OUT FOR SAC1)
 1267 ANA77P=0.
      ALA77F=0.
      AMA77F=0.
      ANA77F=0.
      AA77P=0.
      YA77P=0.
      RETURN
C     ***********
      ENTRY SAC33
C     ***********
      IF (INDAER .EQ. 0) RETURN
      IF (INDARC       ) GO TO 1267
      IF(VS77F.NE.0.)GO TO 1470
      CA =CAMNU
      CN =CNIMNJ
      CY =CYMNU
      CRM=CLMNU
      CM =CMMNU
      CYM=CNZMNU
 1401 TMP(1)=EPS5*CY+EPS6
      TMP(2)=DYNFP*AREFF
      YA77P=TMP(1)*TMP(2)
      ALA77F=(EPS7*CRM+EPS8)*TMP(2)*D2RFF
      ANA77F=(EPS11*CYM+EPS12)*TMP(2)*D2RFF
      TMP(1)=EPS3*CA+EPS4
      TMP(2)=DYNPP*AREFF
      AA77P=TMP(1)*TMP(2)
      ANA77P=(EPS1*CN+EPS2)*TMP(2)
      AMA77F=(EPS9*CM+EPS10)*TMP(2)*D1RFF
      RETURN
 1470 IGO1=1
      IGO2=1
      IGO3=1
      DO 71 I=1,79
 71   TC(I)=0.
 50   HG=HGC7F
      IF(IAP.GE.3)HG=HR
C   EPSLO2 IS COMPUTED IN SUBROUTINE LGEA3C
      TMP(1)=EXP(-4.E*(HG-EPSLO2-HCG)/(D2RFF-HCG)) ,
      DO 79 I=1,2
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
 79   CONTINUE
      DO 80 I=15,16
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
 80   CONTINUE
      DO 81 I=1.,12
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
 81   CONTINUE
      DO 85 I=20,22,2
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
 85   CONTINUE
      IF(INDA80.NE.0)CAVAH =(AERO1(LOC(79),AERO2)-AERO2)*TMP(1)+AERO2
      GO TO (10,20,30),IGO1
```

```
1     DO 82 I=51,53
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
82    CONTINUE
      DO 83 I=59,63
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
83    CONTINUE
      GO TO (11,40),IGO2
11    DO 84 I=27,28
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
84    CONTINUE
      DO 70 I=63,71
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
70    CONTINUE
      GO TO (12,65),IGO3
12    DO 72 I=3,9
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
72    CONTINUE
      DO 73 I=13,14
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
73    CONTINUE
      DO 74 I=17,28
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
74    CONTINUE
      DO 75 I=30,50
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
75    CONTINUE
      DO 76 I=54,55
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
76    CONTINUE
      DO 77 I=64,67
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
77    CONTINUE
      DO 78 I=72,78
      IF(INC(I).NE.0)TC(I)=(AERO1(LOC(I),AERO2)-AERO2)*TMP(1)+AERO2
78    CONTINUE
      TMP(2 )=ABS(ALPHO)
      TMP(4 )=ABS(BETAD)
      TMP(3 )=BETAD**2
      TMP(5 )=ABS(DELQD)
      TMP(6)=ALPHO*ALPHO
      TMP(7)=ABS(DELRD)
      TMP(8)=.5*DEFF/VA77F
      CD =CAVAH+TMP(2)*CAALPH+ALPHO**2*CAALSQ+TMP(4)*CABETA+TMP(3)*
     *    CABTSQ+TMP(5)*CADLTQ+DELQD**2*CADLSQ+ABS(ALPHO*DELQD)*CAALDL+
     *    ABS(ALPHO*BETAD)*CAALBT+ABS(BETAD*DELQD)*CABTDL
      CL =CN1ZER+ALPHO*CN1ALP+ALPHO*TMP(2)*CN1ASQ+TMP(4)*CN1BET+
     *     TMP(3)*CN1BSQ+DELQD*CN1DLQ+TMP(5)*DELQD*CN1DSQ+TMP(2)*DELQD*
     *     CN1ALD+TMP(4)*ALPHO*CN1ALB+TMP(4)*DELQD*CN1BDL+
     *     DEFF/VA77F*ALPHP1/2.*(CN1ADX*DXCGF+CN1ADL)+
     *     DEFF/VA77F*CI77P/2.*(CN1QX *DXCGF+CN1Q   )
      TMP(9)=ALPHO*.0174533
      CA=CD*COS(TMP(9))-CL*SIN(TMP(9))
      CN=CL*COS(TMP(9))+CD*SIN(TMP(9))
      CY=CYZERO+TMP(2)*CYALPH+TMP( 6)*CYALSQ+BETAD*CYBETA+BETAD*TMP(4)*
     *    CYBTSQ+DELRD *CYDELR+TMP( 7)*DELRD*CYDRSQ+TMP(2)*DELRD*CYALDL+
     *    TMP(2)*BETAD *CYALBT+TMP( 4)*DELRD*CYBTDL+
     *    BETAR1*TMP(8)*(CYBTDX*DXCGF+CYBTDT)+
     *    RI77R *TMP(8)*(CYRX   *DXCGF+CYR    )
      TMP(8 )=ABS(ALPHO)
      TMP(11)=ALPHO**2
      TMP(9 )=ABS(BETAD)
      TMP(10)=ABS(DELRD)
      TMP(2 )=DEFF/(VA77F*2.)
      TMP(3)=BETAD*BETAD
      TMP(4)=ABS(DELQD)
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      CRM=CLZERO+TMP(8)*CLALPH+TMP(11)*CLALSQ+TMP(9)*CLBETA+BETAD**2*
     *    CLBTSQ+DELPC *CLDLTP+ABS(DELPD)*DELPD*CLDLSQ+TMP(8)*DELPD*
     *    CLALDL+ABS(ALPHD*BETAD)*CLALBT+TMP(9)*DELPD*CLBTDL+
     *    THP(2)*PI77R*CLP+PI77R*THP(2)*(CLRX*DXCGF+CLR)
      CM =CMZERO+ALPHD*CMALPH+TMP(8)*ALPHD*CMALSQ+TMP(9)*CMBETA+TMP(3)*
     *     CMBTSQ+DELQD*CMDLTQ+TMP(4)*DELQD*CMDLSQ+TMP(8)*CHALDL*DELQD +
     *     TMP(9)*ALPHD*CMALBT+TMP(9)*DELQD*CMBTDL+
     *     D1RFF/VA77F*ALPHR1/2.*(CMADTX*DXCGF+CMALDT)+
     *     D1RFF/VA77F*QI77R /2.*(CMQX   *DXCGF+CMQ    )-
     *     DXCGF/D1RFF*CN
      CYM=CN2ZER+TMP(8)*CN2ALP+TMP(11)*CN2ASQ+BETAD*CN2BET+TMP(9)*BETAD*
     *     CN2BSQ+DELRD *CN2DLT+TMP(10)*CN2DSQ*DELRD+THP(8)*DELRD*CN2ALD+
     *     TMP(8)*BETAD *CN2ALB+TMP(9 )*CN2BDL*DELRD+
     *     TMP(2)*BETAR1*(CN2BDX*DXCGF +CN2BTD)+
     *     TMP(2)*RI77R *(CN2RX *DXCGF +CN2R   )-CY*DXCGF/D2RFF
      GO TO 1401
C     ***********
      ENTRY SACS4
C     ***********
      IF (INDAER .EQ. 0) RETURN
      RETURN
C     ***********
      ENTRY SACS5
C     ***********
      IF (INDAER .EQ. 0) RETURN
 63   CALL STFL(3,1,HBCI)
      IF(INDA80.NE.0)CALL STFL(2,1,C)
      CALL STFL(2,3,B)
 123  CALL STFL(2,3,D)
      RETURN
C     ***********
      ENTRY SACS6
C     ***********
      IF (INDAER .EQ. 0) RETURN
 326  CALL STFL(3,1,HBCI)
      IF(INDA80.NE.0)CALL STFL(1,1,CAVAH)
      CALL STOVAR(3,CA,CN,CY,DU,DU,DU,DU,DU)
 370  CALL STOVAR(3,CRM,CM,CYM,DU,DU,DU,DU,DU)
      RETURN
C     ***********
      ENTRY SACS7
C     ***********
      RETURN
C
C     DETERMINE THE ALPHA THAT MAKES CL=CLRR AND THE
C         ASSOCIATED CDR
C
      ENTRY SACS8
C
C          INPUT FROM CALLING PROGRAM
C     CLRR
C         OUTPUT
C     ALPDES, CDR
C
C          INPUT FROM DIRCOM
C     DELQN, ALPHOS, ALPHDL, HCGD2RFF, INDA01, INDA02, HR,
C     INDA15, INDA16, INDA38, INDA39, INDA40, INDA80
C     INDA20, INDA22, D1RFF, VA77F, PI77F, ALPHR1
C
      IF((IAP.LT.3).OR.(ABS(HG-HR).LE.1.E-6))GO TO 20
      IG01=2
      GO TO 50
 20   TMP(2)=CN1ZER+CN1DLQ*DELQN+CN1DSQ*ABS(DELQN)*DELQN-CLRR
     C+.5*CN1Q*QDESR*D1RFF/VA77F
      ALPDES=AQUAD(CN1ASQ,CN1ALP,TMP(2),ALPHOS,ALPHDL)
```

```
      CDR=CAVAH+CAALPH*ABS(ALPDES)+CAALSQ*ALPDES*ALPDES
      RETURN
C
C     DETERMINE THE CL1 AND CD1 FOR ALPHA=A1
C
      ENTRY SACS9
C
C           INPUT FROM CALLING PROGRAM
C     ALPDES
C           OUTPUT
C     CLRR,CDR
C           INPUT FROM DIRCOM
C     DELQN, HCG, D2RFF, INDA01, INDA02, INDA15, INDA16, HR,
C     INDA38, INDA39, INDA40, INDA83,INDA20, INDA22,
C     D1RFF, VA77F, QI77R, ALPHR1
C
      IF((IAP.LT.3).OR.(ABS(HG-HR).LE.1.E-6))GO TO 30
      IGO1=3
      GO TO 50
 30   CLRR=CN1ZER+CN1ALP*ALPDES+CN1ASQ*ABS(ALPDES)*ALPDES+CN1DLQ
     C*DELQN+CN1DSQ*ABS(DELQN)*DELQN
     C+.5*CN1Q*QDESR*D1RFF/VA77F
      CDR=CAVAH+CAALPH*ABS(ALPDES)+CAALSQ*ALPDES*ALPDES
      RETURN
C
C     EVALUATE NOMINAL DELQN
C
      ENTRY SACS10
C
C           INPUT FROM CALLING PROGRAM - ALPDES
C           OUTPUT - DELQN
C           INPUT FROM DIRCOM
C     DELQL, DELQU, HCG, D1RFF, D2RFF, DYNPP, AREFF, DXCGF, HR,
C     AMT77F, INDA01, INDA02, INDA15, INDA16, INDA38, INDA39, INDA40,
C     INDA83, INDA51, INDA52, INDA53, INDA56, INDA57
C     INDA61, INDAF3, VA77F, ALPHR1, QI77R
C
      IF((IAP.LT.3).OR.(ABS(HG-HR).LE.1.E-6))GO TO 40
      IGO1=1
      IGO2=2
      GO TO 50
 40   TMP(2)=CN1ZER+ALPDES*(CN1ALP+CN1ASQ*ABS(ALPDES))
     C+CN1DLQ*DELQN+CN1DSQ*ABS(DELQN)*DELQN
     C+.5*CN1Q*QDESR*D1RFF/VA77F
      TMP(3)=CAVAH+CAALPH*ABS(ALPDES)+CAALSQ*ALPDES*ALPDES
      TMP(4)=TMP(2)*COS(ALPDES*DEGRAD)+TMP(3)*SIN(ALPDES*DEGRAD)
      TMP(5)=DYNPP*AREFF*D1RFF
      TMP(2)=-TMP(4)*DXCGF*TMP(5)/D1RFF
      TMP(3)=CMDLTQ*TMP(5)
      TMP(4)=(CMZERO+ALPDES*(CMALPH+CMALSQ*ABS(ALPDES)))
     C*TMP(5)+AMT77F+TMP(2)+HM
     C+.5*CMQ*QDESR*D1RFF*TMP(5)/VA77F
      TMP(2)=TMP(5)*CMDLSQ
      DELQN=AQUAD(TMP(2),TMP(3),TMP(4),DELQL,DELQU)
      RETURN
C
C     EVALUATE NOMINAL DELRN
C
      ENTRY SACS11
C
C           INPUT FROM DIRCOM
C     IAP, D2RFF, DYNPP, AREFF, ANT77F, YGW7F1, VA77F
C     DELRL, DELRU
C
      IF((IAP.LT.3).OR.(ABS(HG-HR).LE.1.E-6))GO TO 60
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          IGO4=2
          GO TO 11
 60       BETADE=0.
          IF(IAP.GE.3)BETADE=ASIN(-YGW7F1/VA77F)*57.2957795
          TMP(5)=DYMPP*AREFF*DZRFF
          TMP(6)=DXCGF/DZRFF
          TMP(3)=CN2ULT*TMP(5)
          TMP(2)=CN2USQ*TMP(5)
          TMP(4)=ANT77F+BETADE*(CN2BET-CYBETA*TMP(6)
         C+ABS(BETADE)*(CN2BSQ-CYBTSQ*TMP(6)))*TMP(5)
          DELRN=AQUAD(TMP(2),TMP(3),TMP(4),DELRL,DELRU)
          RETURN
          END
          FUNCTION AERO1(LOCT,AERO2)
          COMMON/TABUIP/C(1)
          AERO1=C(LOCT)
          AERO2=C(LOCT+1)
          RETURN
          END
          FUNCTION AQUAD(A,B,C,XLLIM,XULIM)
          IF(ABS(A).GT.1.E-10)GO TO 4
          X=0.
          IF(ABS(B).LE.1.E-10)GO TO 11
          X=-C/B
          GO TO 11
 4        TMP=B*B-4.*A*C
          IF(TMP.LT.0.)GO TO 30
          TMP1=SQRT(TMP)
          X=(-B+TMP1)*.5/A
          IF(X.LT.0.)GO TO 5
          IF((X.LT.XULIM).AND.(X.GT.XLLIM))GO TO 20
 5        X=(-B-TMP1)*.5/A
          IF(X.LT.0.)GO TO 30
          IF((X.LT.XULIM).AND.(X.GT.XLLIM))GO TO 20
 30       TMP=B*B+4.*A*C
          IF(TMP.LT.0.)GO TO 10
          TMP1=SQRT(TMP)
          X=(-B+TMP1)*.5/(-A)
          IF(X.GT.0.)GO TO 15
          IF((X.LT.XULIM).AND.(X.GT.XLLIM))GO TO 20
 15       X=(-B-TMP1)*.5/(-A)
          IF(X.GT.0.)GO TO 10
 11       IF((X.LT.XULIM).AND.(X.GT.XLLIM))GO TO 20
 10       FX1=XLLIM*(A*ABS(XLLIM)+B)+C
          FX2=XULIM*(A*ABS(XULIM)+B)+C
          X=XLLIM
          IF(ABS(FX1).GT.ABS(FX2))X=XULIM
 20       AQUAD=X
          RETURN
          END
          SUBROUTINE OPT1
          EXTERNAL ASIN,ATAN2
 C                   SIX-DEGREE-OF-FREEDOM OVER FLAT PLANET
          DIMENSION
         *              TMP(27),B(17),D(2),E(2),DRAGG(4),
         *        F       ( 1),H       ( 2),J       ( 3),K       ( 3),
         *L(3),G(2),LA(18)
          LOGICAL INBARC , SW
          COMMON /DIRCOM/
         *DM(22),AA77P,AE77F,DM2(4),AIXR7S,AIXXBS,
         *AIXXS1,AIXYBS,AIXYS1,AIXZBS,AIXZS1,DM3,
         *AIYYBS,AIYYS1,AIYZBS,AIYZS1,DM4,AIZZBS,
         *AIZZS1,DM5(7),AKLT,AKL1,AKL2,AKL3,
         *       AKL4        ,AKL5        ,AKL6        ,AKMT        ,AKM1        ,
         *       AKM2        ,AKM3        ,AKM4        ,AKM5        ,AKM6        ,
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*        AKNT          ,AKN1          ,AKN2          ,AKN3          ,AKN4          ,
*AKN5,AKN6,DM1(31),ALAMTD,ALAMTR,ALA77F,
*ALB77F,DM7(5),ALLJDF,ALMJDF,DM8(2),ALNJDF,ALPHD,DM9(2),
*ALPHR,ALPHR1,ALPLI,DM10(2),ALPTD,ALPTR,
*ALT77F,ALYJDF,ALZJDF,DM11(4),AMACH,DM12(2),AMASS,
*AMASS1,DM13,AMAXH,AMA77F,AMB77F,DM14(2),AMT77F,DM15(4),ANAB7G,
*ANAZ7F,ANA77F,ANB77F,DM16,ANGAMG,ANPSIG,
*ANSIGG,ANTHTG,ANT77F,DM17(2),ANVW7G,DM18,AXP7F,
*AX77F,AYP7F,AY77F,AZP7F,DM19,AZ77F,DM20(4),
*BETAD,DM21(2),BETAR,BETAR1,BETL1,DM22(37),CGAMA,
*CGAMD,DM23(4),CLAMT,DM24(7),CPHIA,CPHIB,DM25,CPHIT,DM26(2),
*CPSIB,DM27(4),CSIGA,CSIGD,DM28(2),CTHTD,DM29,CTHTR,DM30(35)
 COMMON /DI-COM/
*        DCL1          ,DCM1          ,DCN1          ,DCL2          ,DCM2          ,
*DCN2,DCL3,DCM3,DCN3,DM31(9),DCD1,DM32(30),
*DELT1,DELT2,DM33,DLFXP,DLFYP,DLFZP,DM34,
*DELTF,DM35,DLMTF,DLNTF,DLTM1,DLTM2,DM36(2),
*DRAGP,DM37,DXCGF,DM38(3),DYNPP,DM39(37),FXB7P,DM40(3),FYB7P,
*DM41(3),FZB7P,DM42(4),GAMDD,GAMDP,DM199(5),GAML1,GAM7D,
*GAM7R,GAM7R1,GREFF,DM43,GXB7F,DM44(4),GYB7F,DM45(3),
*GZB7F,DM46(6),HGG7F,DM47(41),INDACM,INDADD,INDALP,DM48(2),
*INDAPG,INDARG,DM49(95),INDBAD,DM50(8),
*INDFPA,DM51,INDFPR,INDSCR,DM52,
*INDGRT,INDGSF,DM53(9),INDLDF,DM54(2),INDPLA,DM55(2),INDPSK,
*DM56,INDRMC,DM57(31),INDSDF,INDSKP,INDSPL,INDSTE,DM58,INDSTG,
*DM59(6),INDTSD,DM60,INDWGT,INDWIN,INDXYS,INDXZS,DM61(10),
*DMGRR,DM62T,DM62(4),PA77P,DM63(3),PHIAD,PHIAR,PHIBD,
*DM64([illegible]),PHIFD,PHIPR,DM65(2),PHITD,PHITR,DM66(7),
*PI77D,DM67(5),PSIBD,DM68(4),PSIPD,PSIPR,DM69(6),QI77D,DM70(43),
*RG77N,DM71(2),RHOAS,DM72(2),RI77D,DM73(28),SGAMA,SGAMD,
*DM74(4),SIGDD,SIGDR,SIGL1,DM75,SIG7D,SIG7R,
*SIG7R1,DM76,SLAMT,SPHIA,SPHIB,DM77,SPHIT,DM78(2)
 COMMON /DIRCOM/
*SPSID,DM79(2),SSIGA,SSIGD,DM80(13),STHTD,DM81,STHTR,DM82(17),
*TE77P,DM83(6),THT9D,DM84(3),THTPD,THTPR,THTPD,DM85(3),
*TIME,DM86(2),TIMES,DM87(3),TINSX,DM198(2),TL11,TL12,DM88(6),TVACP,
1DM89,
*TXB7P,DM90(2),TYB7P,DM91([illegible]),TZB7P,DM92(22),UW77F,DM93,
*VA77F,DM94(2),VGPRF,VG77F,DM95(7),VS77F,VW77F,DM96(9),WTR7P,
*WW77F,DM97(9),XGW7F1,DM98,XGZ7F,DM99(5),XN77F,DM100(5),YA77P,
*DM101(8),YGW7F1,DM102,YGZ7F,DM103(6),YN77F,DM104(9),ZGW7F1,
*DM105(7),ZN77F,DM106(108),AL1,DM107,AL17S1,DM108,AL2,
*DM109,AL27S1,DM110,AL3,DM111,AL37S1,DM112(5),AM1,DM113,
*AM17S1,DM114,AM2,DM115,AM27S1,DM116,AM3,DM117,AM37S1,
*DM118,AN1,DM119,AN177S,DM120,AN2,DM121,AN277S,DM122,AN3,
*DM123,AN377S,DM124,PHIBR,DM125(3),PI77R,DM126,
*PI77R1,DM127,PSIBP,DM128(3),QI77R,DM129,QI77R1,DM130,
*RD77N,DM131,RD77N1,DM132,RI77R,DM133,RI77R1,DM134(3),
*THTBP,DM135(11),U777F,DM136,U777F1,DM137,VG77F,DM138
 COMMON/DIRCOM/
*VG77F1,DM139,VGRVF,DM140,VGRVF1,DM141,VP77F,DM142,
*VP77F1,DM143,VTHLF,DM144,VTHLF1,DM145,V777F,DM146,
*V777F1,DM147,W777F,DM148,W777F1,DM149(7),XG77F,
*DM150,XG77F1,DM151(11),YG77F,DM152,YG77F1,DM153(11),
*ZG77F,DM154,ZG77F1,DM1(333),
*ICS,CGCH,SCH,XCH,YCH,ZCH,DM155(235),RHHGP,DM156(48),DM157(2068)
 COMMON/TABFC/DUMM1(39),LOC(4) DUMM2(7)
 COMMON/LG/FXM,FYM,FZM,LM,MM,NM
 COMMON/FLXOP/BH(300).FCX,FCY,FCZ,BHH(300)
 REAL LM,MM,NM,MOX,MOY,MOZ
 EQUIVALENCE ( DM (6) , SW )
 DATA
1(B(I),I=1,17)/4HTIME,5HTIMES,5HXG77F,5HYG77F,5HHG77F,5HU777F,
25HV777F,5HW777F,5HPI77R,5HQI77R,5HRI77R,5HAMACH,5HVA77F,
35HDYNPP,6HXG77F1,6HYG77F1,6HZG77F1/,
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     4D(1),D(2)/5HALPHD,5HBETAD/,E(1),E(2)/6HALPHD1,6HBETAD1/,
     5F(1)/5HVG77F/,G(1),G(2)/5HGAM7D,5HSIG7D/,
     6H(1),H(2)/6HGAM7R1,6HSIG7R1/,(J(I),I=1,3)/5HTHTPD,5HPSIPD,
     75HPHIPD/,(K(I),I=1,3)/5HAXP7F,5HAYP7F,5HAZP7F/,
     8(L(I),I=1,3)/5HAX77F,5HAY77F,5HAZ77F/,
     *                  P /6HTHTRO /
      DATA
     *       HBCI   ,  C     ,  M     /
     *      6H  2SDF,5HRG77N,5HHTR7P/,
     *(DRAGC(I),I=1,4)/3HFDC,3HFCX,3HFCY,3HFCZ/
1     FORMAT (1H0,15X,36HPRINT CODES IDENTIFYING TIME HISTORY)
2     FORMAT (1H0,15X,26HINITIAL PRINT OUT FOR 2SDF)
C45   PRE DATA INITIALIZATION
45    INDSDF=2
      RETURN
C     **********
      ENTRY OPT2
C     **********
C                 (AL17S1,AL1    ,AL27S1,AL2    ,AL37S1,AL3    ,AM17S1,AM1  ,
C    *             AM27S1,AM2    ,AM37S1,AM3    ,AN177S,AN1    ,AN277S,AN2  ,
C    *             AN377S,AN3    ,U777F1,U777F  ,V777F1,V777F  ,W777F1,
C    *             W777F ,PI77R1,PI77R ,QI77R1,QI77R ,RI77R1,RI77R ,
C    *             XG77F1,XG77F ,YG77F1,YG77F ,ZG77F1,ZG77F )
62    CALL INUPD (18,LA)
      CALL LGEAR4
      CALL VPCS4
      CALL TFFS4
      CALL SACS4
      CALL FLEX4
      CALL STFL(0,1,DU)
      CALL LINES (2)
      WRITE (6,2)
      CALL STFL(3,1,HBCI)
      CALL STFL(2,17,B)
      IF(INDGCR.NE.0)CALL STFL(2,1,C)
      IF(INDAPC.NE.0)CALL STFL(2,2,D)
      IF(INDAOD.NE.0)CALL STFL(2,2,E)
      IF(INDGSR.NE.0)CALL STFL(2,1,F)
236   IF (INDFPA.EQ.0) GO TO 250
      CALL STFL(2,2,G)
      IF(INDFPR.NE.0)CALL STFL(2,2,H)
250   IF(INDGRT.NE.0)CALL STFL(2,3,J)
      IF(INDACM.EQ.1)CALL STFL(2,3,K)
      IF(INDACM.EQ.2)CALL STFL(2,3,L)
      IF(INDWGT.NE.0)CALL STFL(2,1,M)
      IF (INDRMC.EQ.0) GO TO 335
      CALL STFL(2,1,P)
C                                       (THTRR1,THTRR )
      CALL INUPD (1,LTHTRR)
335   CALL STFL(2,4,DRAGC)
      CALL LGEAR5
      CALL VPCS5
      CALL TFFS5
      CALL SACS5
      CALL FLEX5
      CALL STFL(0,1,DU)
      CALL DEF
C367  2SDF1
367   ZG77F =-HGC7F
      SIGDD = SIG7D
      GAMDD = GAM7D
      SIGDR = SIGDD*.01745329
      GAMDR = GAMDD*.01745329
      SIGL1 = SIGDR
      GAML1 = GAMDR
```

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```
      SGAMD = SIN(GAMDR)
      CGAMD = COS(GAMDR)
      SSIGD = SIN(SIGDR)
      CSIGD = COS(SIGDR)
      THTBR = THTBD*.01745329
      PSIBR = PSIBD*.01745329
      PHIBR = PHIBD*.01745329
      SPHIB = SIN(PHIBR)
      CPHIB = COS(PHIBR)
      STHTB = SIN(THTBR)
      CTHTB = COS(THTBR)
      SPSIB = SIN(PSIBR)
      CPSIB = COS(PSIBR)
      DCL1=CPSIB*CTHTB
      DCL2=SPSIB
      DCL3=-CPSIB*STHTB
      DCM1=SPHIB*STHTB-CPHIB*SPSIB*CTHTB
      DCM2=CPHIB*CPSIB
      DCM3=SPHIB*CTHTB+CPHIB*STHTB*SPSIB
      DCN1=CPHIB*STHTB+CTHTB*SPSIB*SPHIB
      DCN2=-SPHIB*CPSIB
      DCN3=CPHIB*CTHTB-SPHIB*STHTB*SPSIB
      AL1    = DCL1
      AL2    = DCL2
      AL3    = DCL3
      AM1    = DCM1
      AM2    = DCM2
      AM3    = DCM3
      AN1    = DCN1
      AN2    = DCN2
      AN3    = DCN3
      XG77F1= CSIGD*CGAMD*VG77F
      YG77F1= SSIGD*CGAMD*VG77F
      ZG77F1=-SGAMD*       VG77F
      TMP(1)= XG77F1
      TMP(2)= YG77F1
      TMP(3)= ZG77F1
      CALL INTEG (LA(16) , XG77F1 )
      CALL INTEG (LA(17) , YG77F1 )
      CALL INTEG (LA(18) , ZG77F1 )
      CALL MULT31(DCL1,TMP(1),TMP(4))
      U777F = TMP(4)
      V777F = TMP(5)
      W777F = TMP(6)
      INOSKP=1
      GO TO 702
C     **********
      ENTRY OPT4
C     **********
C621  SOF
 621  DCL1  = AL1
      DCL2  = AL2
      DCL3  = AL3
      DCM1  = AM1
      DCM2  = AM2
      DCM3  = AM3
      DCN1  = AN1
      DCN2  = AN2
      DCN3  = AN3
      TMP(1)= U777F
      TMP(2)= V777F
      TMP(3)= W777F
      CALL TRNPOS (DCL1,TMP(4))
      CALL MULT31 (TMP(4),TMP(1),TMP(13))
      XG77F1= TMP(13)
```

```
      YG77F1= TMP(14)
      ZG77F1= TMP(15)
      CALL INTEG (LA(16) , XG77F1 )
      CALL INTEG (LA(17) , YG77F1 )
      CALL INTEG (LA(18) , ZG77F1 )
C702  SDF2
 702  GXB7F = DCL3*GREFF
      GYB7F = DCM3*GREFF
      GZB7F = DCN3*GREFF
      HGC7F =-ZG77F
      CALL ATMS (HGC7F+RWHGR)
      IF (INDGCR.NE.0) RG77N =
     *             SQRT((XG77F-XGZ7F)**2+(YG77F-YGZ7F)**2)*1.6457925E-4
      IF (INDWIN.NE.0) GO TO 754
      UW77F = 0.
      VW77F = 0.
      WW77F = 0.
      GO TO 1035
 754  GO TO (755,757,761),INDWIN
 755  TMP(1)=TIME
      GO TO 762
 757  TMP(1)=HGC7F
      GO TO 762
 761  TMP(1)=RG77N
 762  CALL TLU(TMP(1),LOC(2),XGW7F1)
      CALL TLU(TMP(1),LOC(3),YGW7F1)
      CALL TLU(TMP(1),LOC(4),ZGW7F1)
      TMP(1)= XGW7F1
      TMP(2)= YGW7F1
      TMP(3)= ZGW7F1
      CALL MULT31 (DCL1,TMP(1),TMP(4))
      UW77F = TMP(4)
      VW77F = TMP(5)
      WW77F = TMP(6)
 1035 VA77F = SQRT((U777F-UW77F)**2+(V777F-VW77F)**2+(W777F-WW77F)**2)
      DYNPP = .5*RHOAS*VA77F**2
      AMACH = 0.
      IF (VS77F.NE.0.) AMACH=VA77F/VS77F
      TMP(1)= U777F-UW77F
      ALPHR = ATAN2(W777F-WW77F,TMP(1))
      BETAR = ATAN2(V777F-VW77F,TMP(1))
      ALPHD = ALPHR*57.2957795
      BETAD = BETAR*57.2957795
      IF (INDSKP.EQ.0) GO TO 1134
                        ALPL1 = ALPHR
                        BETL1 = BETAR
 1134 IF (INDADD.EQ.0) GO TO 1163
      DELT1 = TIME-TL11
      IF (ABS(DELT1).LT.DLTM1) GO TO 1163
      ALPHR1= (ALPHR-ALPL1)/DELT1
      BETAR1= (BETAR-BETL1)/DELT1
                        ALPL1 = ALPHR
                        BETL1 = BETAR
                        TL11  = TIME
C1163 2SDF9
 1163 VG77F = SQRT(XG77F1**2+YG77F1**2+ZG77F1**2)
      IF (VG77F.EQ.0.) GO TO 1314
C1201 2SD10
 1201 TMP(1)=-ZG77F1/VG77F
      IF(ABS(TMP(1)).LT.1.)GO TO 1211
      GAM7R=1.5707963 2*TMP(1)/ABS(TMP(1))
      GO TO 1212
 1211 GAM7R=ASIN(TMP(1))
 1212 GAM7D = GAM7R*57.2957795
      GAMDR = GAM7R
```

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```
      GAMDD = GAM7D
      SIG7R = ATAN2(YG77F1,XG77F1)
      SIGDR = SIG7R
      SIG7D = SIG7R*57.2957795
      SIGDD = SIG7D
C1236 2S011
 1236 SGAMD = SIN(GAMDR)
      CGAMD = COS(GAMDR)
      SSIGD = SIN(SIGDR)
      CSIGD = COS(SIGDR)
      IF (INDFPR.EQ.0) GO TO 1314
      DELT2 = TIME-TL12
      IF (ABS(DELT2).LT.DLTM2)  GO TO 1314
      GAM7R1= (GAMDR-GAML1)/DELT2
      SIG7R1= (SIGDR-SIGL1)/DELT2
                               TL12 = TIME
                               GAML1= GAMDR
                               SIGL1= SIGDR
 1314 IF(INDWIN.NE.0)GO TO 1315
      SGAMA=SGAMD
      GO TO 1316
 1315 IF(VA77F.EQ.0.)GO TO 1316
      SGAMA=(ZG77F1-ZG77E1)/VA77F
 1316 IF(INDPLA.EQ.0)GO TO 1754
C1517 2S015
 1517 IF (INDGRT.EQ.0) GO TO 1701
 1524 IF (DCL1.EQ.0.) GO TO 1536
      THTPR = ATAN2(-DCL3,DCL1)
      THTPD = THTPR*57.2957795
 1536 IF (ABS(DCL2).GT.1.) GO TO 1546
      PSIPR = ASIN(DCL2)
      GO TO 1554
 1546 PSIPR = 1.5707963*DCL2/ABS(DCL2)
 1554 PSIPD = PSIPR*57.2957795
      IF (DCM2.EQ.0.) GO TO 1701
      PHIPR = ATAN2(-DCN2,DCM2)
      PHIPD = PHIPR*57.2957795
 1701 IF (INDACM.EQ.0) GO TO 1754
      IF (AMASS.EQ.0.) CALL EXERR (14)
      AX77F = FX07P/AMASS-GX07F
      AY77F = FY07P/AMASS-GY07F
      AZ77F = FZ07P/AMASS-GZ07F
      IF (INDACM.NE.1) GO TO 1754
      TMP(1)= AX77F
      TMP(2)= AY77F
      TMP(3)= AZ77F
      CALL TRNPOS (DCL1,TMP(19))
      CALL MULT31 (TMP(19),TMP(1),TMP(4))
      AXP7F = TMP(4)
      AYP7F = TMP(5)
      AZP7F = TMP(6)
 1754 CALL VPCS3
      CALL TFFS3
      WTR7P = AMASS*GREFF
C
C     CHUTE DRAG COMPUTATION
C       ICS=1 (FROM LANDING ROLL COMPUTATION,AUTS)
C       ICS=0 (INPUT)
C       CDCH DRAG COEFFICIENT
C       SCH REFERENCE AREA
C       XCH, YCH, ZCH = CHUTE ATTACH POINTS
C
 2061 IF(ICS.EQ.1)GO TO 2050
      FCX=0.
      FCC=0.
```


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```
      FCY=0.
      FCZ=0.
      MDX=0.
      MDY=0.
      MDZ=0.
      GO TO 2062
 2050 FDC=CDCH*SSH*DYNPP
      FCX=-FDC*(U777F-UW77F)/VA77F
      FCY=-FDC*(V777F-VW77F)/VA77F
      FCZ=-FDC*(W777F-WW77F)/VA77F
      MDX=YCH*FCZ-ZCH*FCY
      MDY=ZCH*FCX-XCH*FCZ
      MDZ=XCH*FCY-YCH*FCX
 2062 CALL SACS3
 2125 CALL LGEAR3
      CALL FLEX3
      FXB7P = TXB7P-AA77P +AMASS*GXB7F+DLFXP+FXM+FCX
      FYB7P = TYB7P+YA77P +AMASS*GYB7F+DLFYP+FYM+FCY
      FZB7P = TZB7P-ANA77P+AMASS*GZB7F+DLFZP+FZM+FCZ
      ALB77F= ALT77F+DLLTF+ALA77F+LM+MDX
      AMB77F= AMT77F+DLMTF+AMA77F+MM+MDY
      ANB77F= ANT77F+DLNTF+ANAZ7F+NM+MDZ
      IF (AMASS.EQ.0.) CALL EXERR (14)
      THP(1)= 2.*AMASS1/AMASS
      U777F1= FXB7P/AMASS-QI77R*W777F+RI77R*V777F
      V777F1= FYB7P/AMASS-RI77R*U777F+PI77R*W777F+THP(1)*RI77R*ALYJDF
      W777F1= FZB7P/AMASS-PI77R*V777F+QI77R*U777F-THP(1)*QI77R*ALZJDF
      AKL1   = ALB77F+(AIYYBS-AIZZBS)*QI77R*RI77R
      AKM1   = AMB77F+(AIZZBS-AIXXBS)*PI77R*RI77R
      AKN1   = ANB77F+(AIXXBS-AIYYBS)*PI77R*QI77R
      IF (INDXZS.EQ.0) GO TO 2317
      AKL3   = 0.
      AKM3   = 0.
      AKN3   = 0.
      AKL4   = 0.
      AKM4   = 0.
      AKN4   = 0.
      GO TO 2370
C2317 2S021
 2317 THP(1)= QI77R**2
      THP(2)= RI77R*PI77R
      AKL3   =-AIXYBS *THP(2)
      AKM3   = AIXYBS *RI77R*QI77R
      AKN3   =-AIXYBS *(THP(1)-PI77R**2)
      AKL4   = AIYZBS *(THP(1)-RI77R**2)
      AKM4   =-AIYZBS *PI77R*QI77R
      AKN4   = AIYZBS *RI77R*PI77R
C2370 2S022
 2370 IF (INDXYS.EQ.0) GO TO 2376
      AKL2   = 0.
      AKM2   = 0.
      AKN2   = 0.
      GO TO 2422
C2376 2S023
 2376 AKL2   = AIXZBS*PI77R*QI77R
      AKM2   = AIXZBS*(RI77R**2-PI77R**2)
      AKN2   =-AIXZBS*QI77R*RI77R
C2422 2S024
 2422 AKL5   =-AIXXS1*PI77R+AIXYS1*QI77R+AIXZS1*RI77R+AMASS1*ALLJDF**2*
     *         PI77R
      AKM5   =-AIYYS1*QI77R+AIXYS1*PI77R+AIYZS1*RI77R+AMASS1*ALMJDF**2*
     *         QI77R
      AKN5   =-AIZZS1*RI77R+AIYZS1*QI77R+AIXZS1*PI77R+AMASS1*ALNJDF**2*
     *         RI77R
C 16 2S026
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```
 516 IF (INDRMC.NE.0) GO TO 2524
     AKL6   = 0.
     AKM6   = 0.
     AKN6   = 0.
     GO TO 2615
C2524 25027
 2524 THTRR = THTRD*.01745329
     STHTR = SIN(THTRR)
     CTHTR = COS(THTRR)
     CALL TLU (TIMES,LOC(1),THTRR1)
     CALL INTEG (LTHTRR , THTRR1 )
     THTRD = THTRR*57.2957795
     OMGRR = OMGRT*.104719754
     AKL6   = AIXR7S*OMGRR*(QI77R+THTRR1)*STHTR
     AKM6   =-AIXR7S*OMGRR*(PI77R*STHTR+RI77R*CTHTR)
     AKN6   = AIXR7S*OMGRR*(QI77R+THTRR1)*CTHTR
C2615 25028
 2615 AKLT   = AKL1+AKL2+AKL3+AKL4+AKL5+AKL6
     AKMT   = AKM1+AKM2+AKM3+AKM4+AKM5+AKM6
     AKNT   = AKN1+AKN2+AKN3+AKN4+AKN5+AKN6
     TMP(1)= AIXXBS
     TMP(2)=-AIXYBS
     TMP(3)=-AIXZBS
     TMP(4)=-AIXYBS
     TMP(5)= AIYYBS
     TMP(6)=-AIYZBS
     TMP(7)=-AIXZBS
     TMP(8)=-AIYZBS
     TMP(9)= AIZZBS
     CALL INVP3 (TMP(1),TMP(10),INDEP)
     IF (INDEP.NE.1) CALL EXERR (16)
     TMP(1)= AKLT
     TMP(2)= AKMT
     TMP(3)= AKNT
     CALL MULT31 (TMP(10),TMP(1),TMP(4))
     PI77R1= TMP(4)
     QI77R1= TMP(5)
     RI77R1= TMP(6)
     CALL INTEG (LA(10) , U777F1 )
     CALL INTEG (LA(11) , V777F1 )
     CALL INTEG (LA(12) , W777F1 )
     CALL INTEG (LA(13) , PI77R1 )
     CALL INTEG (LA(14) , QI77R1 )
     CALL INTEG (LA(15) , RI77R1 )
     PI77D = PI77R*57.2957795
     QI77D = QI77R*57.2957795
     RI77D = RI77R*57.2957795
     AL17S1= PI77R*DCM1-QI77R*DCN1
     AL27S1= RI77R*DCM2-QI77R*DCN2
     AL37S1= RI77R*DCM3-QI77R*DCN3
     AM17S1= PI77R*DCN1-RI77R*DCL1
     AM27S1= PI77R*DCN2-PI77R*DCL2
     AM37S1= PI77R*DCN3-RI77R*DCL3
     AN177S= QI77R*DCL1-PI77R*DCM1
     AN277S= QI77R*DCL2-PI77R*DCM2
     AN377S= QI77R*DCL3-PI77R*DCM3
     CALL INTEG (LA( 1) , AL17S1 )
     CALL INTEG (LA( 2) , AL27S1 )
     CALL INTEG (LA( 3) , AL37S1 )
     CALL INTEG (LA( 4) , AM17S1 )
     CALL INTEG (LA( 5) , AM27S1 )
     CALL INTEG (LA( 6) , AM37S1 )
     CALL INTEG (LA( 7) , AN177S )
     CALL INTEG (LA( 8) , AN277S )
     CALL INTEG (LA( 9) , AN377S )
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```
      DCL1 = AL1
      DCL2 = AL2
      DCL3 = AL3
      DCM1 = AM1
      DCM2 = AM2
      DCM3 = AM3
      DCN1 = AN1
      DCN2 = AN2
      DCN3 = AN3
      CALL INVR3 (DCL1,TMP(1),INDER)
      IF (INDER.NE.1) CALL EXERR (17)
      CALL TRNPOS (TMP(1),TMP(10))
      AL1 = .5*(AL1+TMP(10))
      AL2 = .5*(AL2+TMP(13))
      AL3 = .5*(AL3+TMP(16))
      AM1 = .5*(AM1+TMP(11))
      AM2 = .5*(AM2+TMP(14))
      AM3 = .5*(AM3+TMP(17))
      AN1 = .5*(AN1+TMP(12))
      AN2 = .5*(AN2+TMP(15))
      AN3 = .5*(AN3+TMP(18))
      INDSKP= 
      INDARG = HGC7F .GT. AMAXH
      CALL STGTST (INDSTG)
      IF (SW   .OR.  HGC7F.GT. J.) RETURN
      INDSTE = 
      WRITE (6,10)
 10   FORMAT (1H ,15X,10HSTOP-HGC7F)
      RETURN
C     **********
      ENTRY OPT6
C     **********
 3340 CALL STFL(3,1,HBCI)
      CALL STOVAR (8,TIME ,TIMES ,XG77F ,YG77F ,HGC7F,U777F,V777F,W777F)
      CALL STOVAR (8,PI77R,QI77R,RI77R,AMACH,VA77F ,DYNPP,XG77F1,YG77F1)
      CALL STFL(1,1,ZG77F1)
      IF(INDAPC.NE.0)CALL STOVAR(2,ALPHD,BETAD,DU,DU,DU,DU,DU,DU)
      IF(INDADD.EQ.0)GO TO 3341
      ALPHD1=ALPHR1*57.2957795
      BETAD1=BETAR1*57.2957795
      CALL STOVAR(2,ALPHD1,BETAD1,DU,DU,DU,DU,DU,DU)
 3341 IF(INDGSP.NE.0)CALL STFL(1,1,VG77F)
      IF(INDFPA.NE.0)CALL STOVAR(2,GAM7D,SIG7D,DU,DU,DU,DU,DU,DU)
      IF(INDFPR.NE.0)CALL STOVAR(2,GAM7R1,SIG7R1,DU,DU,DU,DU,DU,DU)
      IF(INDGRT.NE.0)CALL STOVAR(3,THTPD,PSIPD,PHIPD,DU,DU,DU,DU,DU)
      IF(INDACM.EQ.1)CALL STOVAR(3,AXP7F,AYP7F,AZP7F,DU,DU,DU,DU,DU)
      IF(INDACM.EQ.2)CALL STOVAR(3,AX77F,AY77F,AZ77F,DU,DU,DU,DU,DU)
      IF(INDWGT.NE.0)CALL STFL(1,1,WTR7P)
      IF(INDRMC.NE.0)CALL STFL(1,1,THTRD)
      CALL STOVAR(4,FDC,FCX,FCY,FCZ,DU,DU,DU,DU)
      CALL LGEAR6
      CALL VPC36
      CALL TFF36
      CALL SACS6
      CALL FLEX6
      CALL STFL(0,1,DU)
      RETURN
C     **********
      ENTRY OPT7
C     **********
      TIME = DM(3)
      TIMES= DM(3) - TIMSX
      CALL UPDAT (5,LA(1 ) ,AL1,AL2,AL3,AM1,AM2 )
      CALL UPDAT (5,LA(6 ) ,AM3,AN1,AN2,AN3,U777F  )
      CALL UPDAT (5,LA(11) ,V777F,W777F,PI77R,QI77R,RI77R )
```

```
      CALL UPDAT(3,LA(16),XG77F,YG77F,ZG77F,DU,DU)
      IF(INORMC.NE.0) CALL UPDAT(1,LTHTRR,THTRP,DU,DU,DU,DU)
      CALL LGEAR7
      CALL VPCS7
      CALL TFFS7
      CALL SACS7
      CALL FLEX7
      RETURN
      END
      SUBROUTINE LGEAR1
      COMMON/DIRCOM/DM1(136),AMASS,DM2(147),DCL1,DCM1,
     CDCN1,DCL2,DCM2,DCN2,DCL3,DCM3,DCN3,DM3(99),FXB7P,
     CDUM4(3),FYB7P(4),FZB7P,DM5(17),GXB7F,DM6(8),GZB7F,
     CDM7(218),INDSTE(235),
     CTIME,DM8(207),PI77R(2),PI77R1(2),DM9(4),
     CQI77P(2),QI77R1(2),DM10(4),RI77R(2),RI77R1(2),DM11(48),
     CXG77F(2),XG77F1(12),YG77F(2),YG77F1(12),
     CZG77F(2),ZG77F1(2),DUM13(52),
     CNSTRUT,MASS(5),RX(5),RY(5),RZ(5),THETAU(5),ERDEG,RGR,
     CNTIRES(5),FZERO(5),H(5),DELTAM(5),MOMENT(5),
     CRF(5),VZ   ,ITD,PZERO(5),VZERO(5),A(5),P20(5),V20(5),
     CA2(5),IL,S2T(5),ES2(5),C2L(5),MASS2(5),MUS(5),
     CCC(5),CE(5),C2C(5),C2L(5),NVGPT,NPP,MB(5),RLT,NDELTA,
     CES(5),SB(5),SD21(2),SD22(2),SD23(2),SD24(2),SD25(2)
      COMMON/DIRCOM/
     CSD11(2),SD12(2),SD13(2),SD14(2),SD15(2),
     CS1(2),S2(2),S3(2),S4(2),S5(2),
     CS2D21(2),S2D22(2),S2D23(2),S2D24(2),S2D25(2),
     CS2D11(2),S2D12(2),S2D13(2),S2D14(2),S2D15(2),
     CS21(2),S22(2),S23(2),S24(2),S25(2),
     COMTD11(2),OMTD12(2),OMTD13(2),OMTD14(2),OMTD15(2),
     COMT1(2),OMT2(2),OMT3(2),OMT4(2),OMT5(2),
     CAI(5),BI(5),DELTA1,DELTA2,DELTA3,DELTA4,DELTA5,
     CDDELT1,DDELT2,DDELT3,DDELT4,DDELT5,ISTAGE,
     CPRTMIN,IPLT,ISOF,ISTPL1,ISTPL2,ISTPL3,ISTPL4,ISTPL5,
     CDM14(22),IB(5),DM15(127),INULG,DM16(107),CASK(44),
     *DM17,NMODL,DM18(4),SXMOD(100),SYMOD(100),SZMOD(100),DM19(1686),
     *GDU2(2),DCM2(2)
      REAL MASS,MOMENT,    MASS2,MUS,NTIRES,MB
      DIMENSION DLGAUT(14),DLGDE(47),DLG(7),DLGE(299)
      COMMON/LGAUTS/ARG11,ARG13,ARG31,ARG33,AMA(5),VAXLE(5)
      COMMON/LGDE/LA(25),FC2(5),P2(5),PRES(5),C(5),IPPT,LTPT
      COMMON/LG/FXM,FYM,FZM,LM,MM,NM,EPSLO2
      COMMON/LGE/A11(5),A13(5),A31(5),A33(5),RRCGX(5),
     CRL(3,3),RI(3,3,5),RAX(5),RAY(5),RAZ(5),TMP(3),ZZERO(5),
     CXR(5),YR(5),EPSLON(5),PA(5),FDELTA(5),
     CFTRZ(5),RDX(5),RDY(5),RDZ(5),RDXG(5),RDYG(5),RDZG(5),
     CVTX(5),VTY(5),VTZ(5),GZ(5),        VGPT(5),FTRX(5),FTRY(5),
     CDX(5),DY(5),DZ(5),FT(5),FDX(5),FDY(5),FF(5),AA(5),C2(5),
     CSR(5),SF(5),PSKD(5),MUVP(5),MTRX(5),MTRY(5),
     CMTRZ(5),MA(5),RG11,RG13,RG31,RG33,IPRT,
     CMTX,MTY,MTZ,SFTRX,SFTRY,SFTRZ,FTRA,
     CFTRB,FTRC,SMTRX,SMTRY,SMTRZ
      COMMON/FLXOP/GFORC2(100),GFORC3(100),GFORC4(100),BH1(308)
      EQUIVALENCE  (DLGAUT(1),ARG11),(DLGDE(1),LA(1)),
     *(DLG(1),FXM),(DLGE(1),A11(1))
      COMMON/TABSPC/DUMM1(123),LOC(7)
      COMMON/HTCOM/HT,HT1,HT2
      REAL MUVP,MTRX,MTRY,MTRZ,MA,
     CMTX,MTY,MTZ,LM,MM,NM
      DIMENSION DELTA(5),DDELTA(5),P(5),
C          SD2(2,5),SD1(2,5),S(2,5),S2D2(2,5),S2D1(2,5),S2(2,5),
     COMETD1(2,5),OMET(2,5)
      EQUIVALENCE  (P(1),PRES(1))
      EQUIVALENCE  (DELTA(1),DELTA1),(DDELTA(1),DDELT1)
```

```
      EQUIVALENCE
     C(SD21(1),SD2(1,1)),(SD11(1),SD1(1,1)),(S1(1),S(1,1)),
     C(S2D21(1),S2D2(1,1)),(S2D11(1),S2D1(1,1)),(S21(1),S2(1,1)),
     C(OMTD11(1),OMETD1(1,1)),(OMT1(1),OMET(1,1))
C     PRE DATA INITIALIZATION
      DO 1 I=1,14
1     DLGAUT(I)=0.
      DO 2 I=1,47
2     DLGDE(I)=0.
      DO 3 I=1,7
3     DLG(I)=0.
      DO 4 I=1,299
4     DLGE(I)=0.
      ISTAGE=0
      IPLT=0
      IPPT=0
      LTPT=1
      ISDF=6
      ISTPL1=0
      ISTPL2=0
      ISTPL3=0
      ISTPL4=0
      ISTPL5=0
      EPSLO2=0.
      RETURN
C     **********
      ENTRY LGEAR2
C     **********
      FXM=0.
      FYM=0.
      FZM=0.
      LM=0.
      MM=0.
      NM=0.
      ERR=.01745329*ERDEG
      RG11=COS(ERR)
      RG13=-SIN(ERR)
      RG31=-RG13
      RG33=RG11
      ARG11=RG11
      ARG13=RG13
      ARG31=RG31
      ARG33=RG33
      IF(INDLG.EQ.0)RETURN
C     INITIALIZATION AFTER DATA READ IN
C        VARIABLES TO BE INTEGRATED
C           (OMTD11,OMT1  )
C           (OMTD12,OMT2  )
C           (OMTD13,OMT3  )
C           (OMTD14,OMT4  )
C           (OMTD15,OMT5  )
C           (SD21  ,SD11  )          (SD11  ,S1    )
C           (SD22  ,SD12  )          (SD12  ,S2    )
C           (SD23  ,SD13  )          (SD13  ,S3    )
C           (SD24  ,SD14  )          (SD14  ,S4    )
C           (SD25  ,SD15  )          (SD15  ,S5    )
C           (S2D21 ,S2D11 )          (S2D11 ,S21   )
C           (S2D22 ,S2D12 )          (S2D12 ,S22   )
C           (S2D23 ,S2D13 )          (S2D13 ,S23   )
C           (S2D24 ,S2D14 )          (S2D14 ,S24   )
C           (S2D25 ,S2D15 )          (S2D15 ,S25   )
      IF(INDLG.EQ.2)GO TO 5
      NDEQ=5*NSTRUT
      IF(IL.NE.0)NDEQ=3*NSTRUT
      CALL INUPJ(NDEQ,LA)
```

```
      DO 10 I=1,NSTRUT
      THETAR=.01745329*THETAD(I)
      A11(I)=COS(THETAR)
      A13(I)=-SIN(THETAR)
      A31(I)=-A13(I)
      A33(I)=A11(I)
 10   RRCGX(I)=A11(I)*RX(I)+A13(I)*RZ(I)
      IPRT=1
      RETURN
C     **********
C     INITIAL PRINT
      ENTRY LGEAR4
C     **********
      RETURN
C     **********
      ENTRY LGEAR3
C     **********
C     MAIN COMPUTATIONAL AREA
C     RL MATRIX ELEMENTS
      IF(INDLG.EQ.0)RETURN
      RL(1,1)=DCL1*RG11+DCL3*RG13
      RL(1,2)=DCL2
      RL(1,3)=DCL1*RG31+DCL3*RG33
      RL(2,1)=DCM1*RG11+DCM3*RG13
      RL(2,2)=DCM2
      RL(2,3)=DCM1*RG31+DCM3*RG33
      RL(3,1)=DCN1*RG11+DCN3*RG13
      RL(3,2)=DCN2
      RL(3,3)=DCN1*RG31+DCN3*RG33
      CALL LGEA3L
C     CALCULATION OF S2D2, S2D1, AND S2
      DO 100 I=1,NSTRUT
      IF(INDLG.EQ.2)GO TO 20
      IF(IL.NE.1)GO TO 59
      TMP(1)=SD1(1,I)-A2(I)*S2D1(1,I)/A(I)
      S2D2(1,I)=((P(I)-P2(I))*A2(I)+C(I)*TMP(1)*ABS(TMP(1))
     C-S2D1(1,I)*(C2(I)*ABS(S2D1(1,I))+C2L(I)))
     C/MASS2(I)+GZ(I)-SR(I)+SD2(1,I)
      HT2=HT
      IF(S2D1(1,I))86,87,88
 86   TTIME=S2(1,I)/ABS(S2D1(1,I))
 89   IF(TTIME.GE.HT)GO TO 87
      HT2=TTIME
      GO TO 87
 88   TTIME=(S2T(I)-S2(1,I))/S2D1(1,I)
      GO TO 89
 87   CONTINUE
      IF(S2(1,I).GT.(-ES2(I)))GO TO 58
      WRITE(6,57)I,I,S2(1,I)
 57   FORMAT(58X,5H-ES2(,I1,10H) EXCEEDED/
     C58X,3HS2(,I1,4H) = E15.7)
 58   IF(S2(1,I).LE.ES2(I))GO TO 61
      IF(S2(1,I).LE.(S2T(I)-ES2(I)))GO TO 141
      IF(S2(1,I).LE.(S2T(I)+ES2(I)))GO TO 62
      WRITE(6,63)I,I,S2(1,I)
 63   FORMAT(58X,5H ES2(,I1,10H) EXCEEDED/
     C58X,3HS2(,I1,4H) = E15.7)
 62   IF(S2D1(1,I).GT.0.)S2D1(1,I)=0.
      IF(S2D2(1,I).LT.0.)GO TO 141
      GO TO 140
 61   IF(S2D1(1,I).LT.0.)S2D1(1,I)=0.
      IF(S2D2(1,I).LT.0.)GO TO 140
 141  FC2(I)=0.
      GO TO 60
 140  FC2(I)=-MASS2(I)*S2D2(1,I)
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```
      S2D2(1,I)=0.
      GO TO 60
59    S2D2(1,I)=0.
      S2D1(1,I)=0.
      S2(1,I)=0.
      FC2(I)=-(P(I)-P2(I))*A2(I)-C(I)*SD1(1,I)*ABS(SD1(1,I))
      GO TO 94
60    CONTINUE
      I1=2*I+3*NSTRUT-1
      I2=I1+1
      CALL INTEG(LA(I1),S2D2(1,I))
      CALL INTEG(LA(I2),S2D1(1,I))
94    CONTINUE
C     COMPUTATION OF AA(I)
      TMP(2)=0.
      IF(SD1(1,I).NE.0.)TMP(2)=SD1(1,I)/ABS(SD1(1,I))
      SF(I)=-P(I)*(A(I)-A2(I))-P2(I)*A2(I)+FC2(I)-S2D1(1,I)*
     C(C2(I)*ABS(S2D1(1,I))+C2L(I))-FF(I)*TMP(2)
      AA(I)=(FT(I)+SF(I))/MASS(I)
C     CALCULATION OF SD2, SD1, AND S
C     CALCULATION OF OMETD1(I) AND OMET(I)
      SD2(1,I)=SR(I)+AA(I)-GZ(I)
      HT1=HT
      IF(SD1(1,I))76,77,78
76    TTIME=S(1,I)/ABS(SD1(1,I))
79    IF(TTIME.GE.HT)GO TO 77
      HT1=TTIME
      GO TO 77
78    TTIME=(S0(I)-S(1,I))/SD1(1,I)
      GO TO 79
77    CONTINUE
      IF(S(1,I).GT.(-ES(I)))GO TO 50
      WRITE(6,49)I,I,S(1,I)
49    FORMAT(58X,4H-ES(,I1,10H) EXCEEDED/
     C58X,2HS(,I1,4H) = E15.7)
50    IF(S(1,I).LE.ES(I))GO TO 51
      IF(S(1,I).LE.(S0(I)-ES(I)))GO TO 55
      IF(S(1,I).LE.(S0(I)+ES(I)))GO TO 52
      WRITE(6,53)I,I,S(1,I)
53    FORMAT(58X,4H ES(,I1,10H) EXCEEDED/
     C58X,2HS(,I1,4H) = E15.7)
52    IF(SD1(1,I).GT.0.)SD1(1,I)=0.
      IF(SD2(1,I).LT.0.)GO TO 55
      SD2(1,I)=0.
      GO TO 55
51    IF(SD1(1,I).LT.0.)SD1(1,I)=0.
      IF(SD2(1,I).LT.0.)SD2(1,I)=0.
55    CONTINUE
      I2=2*I+NSTRUT-1
      I1=I2+1
      CALL INTEG(LA(I2),SD2(1,I))
      CALL INTEG(LA(I1),SD1(1,I))
20    TMP(1)=RZEPO(I)-DELTA(I)
      IF(CASK(I).GT.1.E-10)GO TO 200
      MA(I)=-FTRY(I)*TMP(1)*RI(2,1,I)+FTRX(I)*TMP(1)
     C*RI(2,2,I)
      GO TO 201
200   MA(I)=TMP(1)*SQRT(FTRY(I)*FTRY(I)+FTRX(I)*FTRX(I))
      MA(I)=SIGN(MA(I),-VAXLE(I)-OMET(1,I)*TMP(1))
201   AMA(I)=MA(I)
      IF(INDLG.EQ.2)GO TO 100
      IF(IB(I).NE.(-1))GO TO 48
      OMETD1(1,I)=0.
      OMET(1,I)=0.
      GO TO 21
```

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      TMP(1)=0.
      IF(OMET(1,I).NE.0.)TMP(1)=OMET(1,I)/ABS(OMET(1,I))
      OMETD1(1,I)=(MA(I)-MB(I)*TMP(1))/(NTIRES(I)*MOMENT(I))
   21 CALL INTEG(LA(I),OMETD1(1,I))
  100 CONTINUE
C     CALCULATION OF FTRA, FTRB, AND FTRC
      SFTRX=0.
      SFTRY=0.
      SFTRZ=0.
      DO 70 I=1,NSTRUT
      SFTRX=SFTRX+FTRX(I)
      SFTRY=SFTRY+FTRY(I)
   70 SFTRZ=SFTRZ+FTRZ(I)
      FTRA=RL(1,1)*SFTRX+RL(1,2)*SFTRY+RL(1,3)*SFTRZ
      FTRB=RL(2,1)*SFTRX+RL(2,2)*SFTRY+RL(2,3)*SFTRZ
      FTRC=RL(3,1)*SFTRX+RL(3,2)*SFTRY+RL(3,3)*SFTRZ
C     CALCULATION OF MTX, MTY, AND MTZ
      SMTRX=0.
      SMTRY=0.
      SMTRZ=0.
      DO 75 I=1,NSTRUT
      SMTRX=SMTRX+MTRX(I)
      SMTRY=SMTRY+MTRY(I)
   75 SMTRZ=SMTRZ+MTRZ(I)
      MTX=RL(1,1)*SMTRX+RL(1,2)*SMTRY+RL(1,3)*SMTRZ
      MTY=RL(2,1)*SMTRX+RL(2,2)*SMTRY+RL(2,3)*SMTRZ
      MTZ=RL(3,1)*SMTRX+RL(3,2)*SMTRY+RL(3,3)*SMTRZ
C     CALCULATION OF FXM, FYM, FZM, LM, MM, AND NM
      FYM=0.
      FZM=0.
      FXM=0.
      LM=0.
      MM=0.
      NM=0.
      BFX=0.
      BFY=0.
      BFZ=0.
      BLM=0.
      BMM=0.
      BNM=0.
      DO 82 I=1,NSTRUT
      DFXM=0.
      DFYM=0.
      DFZM=0.
      DLM=0.
      DMM=0.
      DNM=0.
      DO 14 IL4=1,NMODE
      NBB=(IL4-1)*NSTRUT+I
      DFXM=DFXM-MASS(I)*SXMOD(NBB)*GQD2(IL4)
      DFYM=DFYM-MASS(I)*SYMOD(NBB)*GQD2(IL4)
      DFZM=DFZM-MASS(I)*SZMOD(NBB)*GQD2(IL4)
      NBH=(I-1)*NMODE+IL4
      DLM=DLM-MASS(I)*GFORC2(NBH)*GQD2(IL4)
      DMM=DMM-MASS(I)*GFORC3(NBH)*GQD2(IL4)
   14 DNM=DNM-MASS(I)*GFORC4(NBH)*GQD2(IL4)
      BFX=BFX+DFXM
      BFY=BFY+DFYM
      BFZ=BFZ+DFZM
      BLM=BLM+DLM
      BMM=BMM+DMM
      BNM=BNM+DNM
      TMP(1)=MASS(I)*QD2(1,I)
      FXM=FXM+TMP(1)*A31(I)
      FYM=FYM
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      FZM=FZM+TMP(1)*A33(I)
      LM=LM+TMP(1)*A11(I)*RY(I)
      MM=MM-TMP(1)*RRCGX(I)
   82 NM=NM+TMP(1)*A13(I)*RY(I)
      FXM=FXM+BFX+FTRA
      FYM=FYM+BFY+FTRB
      FZM=FZM+BFZ+FTRC
      LM=LM+BLM+MTX
      MM=MM+BMM+MTY
      NM=NM+BNM+MTZ
      RETURN
      END
      SUBROUTINE LGEA3C
      COMMON/DIRCOM/DM1(136),AMASS,DM2(147),DCL1,DCM1,
     CDCN1,DCL2,DCM2,DCN2,DCL3,DCM3,DCN3,DM3(99),FX07P,
     CDUM4(3),FY07P(4),FZ07P,DM5(17),GX07F,DM6(8),GZ07F,
     CDM7(186),INDCL1,INDCL2,INDCL3,INDCL4,DM15(28),INDSTE,DM18(234),
     CTIME,DM8(287),PI77R,DM16,PI77R1,DM9(5),
     CQI77R,DM24,QI77R1,DM10(5),RI77R,DM17,RI77R1,DM11(49),
     CXG77F,DM19,XG77F1,DM20(11),YG77F,DM21,YG77F1,DM22(11),
     CZG77F,DM23,ZG77F1,DUM13(46),NSMAIN,NSCNDY(6),
     CNSTRUT,MASS(5),RX(5),RY(5),RZ(5),THETAD(5),ERDEG,RGR,
     CNTIRES(5),RZERO(5),W(5),DELTAM(5),MOMENT(5),
     CRF(5),VZ   ,IFD,PZERO(5),VZERO(5),A(5),P20(5),V20(5),
     CA2(5),IL,S2T(5),ES2(5),C2L(5),MASS2(5),MUS(5),
     CCC(5),CE(5),C20(5),C2E(5),NVGPT,NPP,MB(5),RLT,NDELTA,
     CES(5),SD(5),SD21(2),SD22(2),SD23(2),SD24(2),SD25(2)
      COMMON/DIRCOM/
     CSD11(2),SD12(2),SD13(2),SD14(2),SD15(2),
     CS1(2),S2(2),S3(2),S4(2),S5(2),
     CS2D21(2),S2D22(2),S2D23(2),S2D24(2),S2D25(2),
     CS2D11(2),S2D12(2),S2D13(2),S2D14(2),S2D15(2),
     CS21(2),S22(2),S23(2),S24(2),S25(2),
     COMTD11(2),OMTD12(2),OMTD13(2),OMTD14(2),OMTD15(2),
     COMT1(2),OMT2(2),OMT3(2),OMT4(2),OMT5(2),
     CAI(5),BI(5),DELTA1,DELTA2,DELTA3,DELTA4,DELTA5,
     CDDELT1,DDELT2,DDELT3,DDELT4,DDELT5,ISTAGE,
     CPRTMIN,IPLT,ISOF,ISTPL1,ISTPL2,ISTPL3,ISTPL4,ISTPL5,
     CDM14(262),CASK(5),DM25(39),DM26,NMODE,DM27(40),SXMOD(100),
     *SYMOD(100),SZMOD(100),DM28(1646),GQ(20),GQD1(20),GQD2(20),
     *DDM29(20)
      REAL MASS,MOMENT,   MASS2,MUS,NTIRES,MB
      COMMON/LGAUTS/ARG11,ARG13,ARG31,ARG33,AMA(5),VAXLE(5)
      COMMON/LGDE/LA(25),FC2(5),P2(5),PRES(5),C(5),IPPT,LTPT
      COMMON/LG/FXM,FYM,FZM,LM,MM,NM,EPSL02
      COMMON/LGE/A11(5),A13(5),A31(5),A33(5),RRCGX(5),
     CRL(3,3),RI(3,3,5),RAX(5),RAY(5),RAZ(5),TMP(3),ZZERO(5),
     CXR(5),YR(5),EPSLON(5),PA(5),FDELTA(5),
     CFTRZ(5),RDX(5),RDY(5),RDZ(5),RDXG(5),RDYG(5),RDZG(5),
     CVTX(5),VTY(5),VTZ(5),GZ(5),        VGPT(5),FTRX(5),FTRY(5),
     CDX(5),DY(5),DZ(5),FT(5),FDX(5),FDY(5),FF(5),AA(5),C2(5),
     CSR(5),SF(5),PSKD(5),MUVP(5),MTRX(5),MTRY(5),
     CMTRZ(5),MA(5),RG11,RG13,RG31,RG33,IPRT,
     CMTX,MTY,MTZ,SFTRX,SFTRY,SFTRZ,FTRA,
     CFTRB,FTRC,SMTRX,SMTRY,SMTRZ
      COMMON/TABSRC/DUMM1(103),LOC(7)
      REAL MUVP,MTRX,MTRY,MTRZ,MA,
     CMTX,MTY,MTZ,LM,MM,NM
      DIMENSION DELTA(5),DDELTA(5),P(5),
C           SD2(2,5),SD1(2,5),S(2,5),S2D2(2,5),S2D1(2,5),S2(2,5),
     COMETD1(2,5),OMET(2,5)
      DIMENSION TEMP1(3),TEMP2(3)
      EQUIVALENCE (P(1),PRES(1))
      EQUIVALENCE (DELTA(1),DELTA1),(DDELTA(1),DDELT1)
      EQUIVALENCE
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      C(SD21(1),SD2(1,1)),(SD11(1),SD1(1,1)),(S1(1),S(1,1)),
      C(S2D21(1),S2D2(1,1)),(S2D11(1),S2D1(1,1)),(S21(1),S2(1,1)),
      C(OMTD11(1),OMETD(1,1)),(OMT1(1),OMET(1,1))
       DO 100 I=1,NSTRUT
       FI=I
C      RI MATRIX ELEMENTS
       DO 20 J=1,3
       TEMP1(J)=0.
       TEMP2(J)=0.
       RI(1,J,I)=A11(I)*RL(1,J)+A13(I)*RL(3,J)
       RI(2,J,I)=RL(2,J)
 20    RI(3,J,I)=A31(I)*RL(1,J)+A33(I)*RL(3,J)
C      POSITION DEPENDENT CALCULATIONS
       DO 11 ILP=1,NMODE
       NOD=(ILP-1)*NSTRUT+I
       TEMP1(1)=TEMP1(1)+SXMOD(NOD)*GQ(ILP)
       TEMP1(2)=TEMP1(2)+SYMOD(NOD)*GQ(ILP)
 11    TEMP1(3)=TEMP1(3)+SZMOD(NOD)*GQ(ILP)
       TMP(1)=RF(I)-S(1,I)
       TMP(2)=RX(I)+A31(I)*TMP(1)+TEMP1(1)
       TMP(3)=RZ(I)+A33(I)*TMP(1)+TEMP1(3)
       RAX(I)=DCL1*TMP(2)+DCM1*(RY(I)+TEMP1(2))+DCN1*TMP(3)
       RAY(I)=DCL2*TMP(2)+DCM2*(RY(I)+TEMP1(2))+DCN2*TMP(3)
       RAZ(I)=DCL3*TMP(2)+DCM3*(RY(I)+TEMP1(2))+DCN3*TMP(3)
       TMP(1)=(XG77F-RGP+RAX(I))
       TMP(2)=ZG77F+RAZ(I)
       ZZERO(I)=TMP(1)*RG31+TMP(2)*RG33
       XR(I)=TMP(1)*RG11+TMP(2)*RG13
       YR(I)=YG77F  +RAY(I)
       IF(XR(I).LE.0.)GO TO 25
       IF(XR(I).GE.FLT)GO TO 25
       CALL TLU(XR(I),LOC(2),EPSLON(I))
       GO TO 24
 25    EPSLON(I)=0.
 24    DELTA(I)=RZERO(I)+ZZERO(I)+EPSLON(I)
       DDELTA(I)=DELTA(I)
       IF(DELTA(I).LE.0.)GO TO 26
       IF(DELTA(I).LE.DELTAM(I))GO TO 27
       WRITE(6,28) I,DELTA(I)
 28    FORMAT(35X,24HTIRE DEFLECTION EXCEEDED,10X,6HDELTA(,I1,4H) = ,
      CE15.7)
       CALL LGEASP
       INDSTE=0
       RETURN
 26    DELTA(I)=0.
 27    CONTINUE
       P(I)=PZERO(I)*VZERO(I)/(VZERO(I)+A2(I)*S2(1,I)-
      CS(1,I)*A(I))
       P2(I)=0.
       TMP(1)=V20(I)-A2(I)*S2(1,I)
       IF(TMP(1).EQ.0.)GO TO 31
       P2(I)=P20(I)*V20(I)/TMP(1)
 31    IF(IFD.EQ.0)GO TO 32
       FDELTA(I)=0.
       IF(DELTA(I).NE.0.)FDELTA(I)=AI(I)*(DELTA(I))**BI(I)
       GO TO 33
 32    CALL HIHC(3,LOC(1),NDELTA,NSTRUT,DU,DU,DELTA(I),FI,DU,DU,FDELTA(I)
      1)
 33    FTRZ(I)=-NTIRES(I)*FDELTA(I)
C      CALCULATION OF COMPONENTS OF GROUND PLANE
C      VELOCITIES VTX(I) AND VTY(I)
       TMP(1)=(RF(I)-S(1,I))
       DO 12 IL2=1,NMODE
       ND=(IL2-1)*NSTRUT+I
       TEMP2(1)=TEMP2(1)+(QI77R*SZMOD(ND)-RI77R*SYMOD(ND))*GQ(IL2)
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     C+SXMOD(ND)*GOD1(IL2)
      TEMP2(2)=TEMP2(2)+(RI77R*SXMOD(ND)-PI77R*SZMOD(ND))*GQ(IL2)
     C+SYMOD(ND)*GOD1(IL2)
 12   TEMP2(3)=TEMP2(3)+(PI77R*SYMOD(ND)-QI77R*SXMOD(ND))*GQ(IL2)
     C+SZMOD(ND)*GOD1(IL2)
      RDX(I)=-SD1(1,I)*A31(I)+QI77R*(TMP(1)*A33(I)+RZ(I))-RI77R
     C*RY(I)+TEMP2(1)
      RDY(I)=TMP(1)*(RI77R*A31(I)-PI77R*A33(I))+RI77R*RX(I)-PI77R
     C*RZ(I)+TEMP2(2)
      RDZ(I)=-SD1(1,I)*A33(I)-TMP(1)*QI77R*A31(I)+PI77R*RY(I)-QI77R
     C*RX(I)+TEMP2(3)
      RDXG(I)=XG77F1+DCL1*RDX(I)+DCM1*RDY(I)+DCN1*RDZ(I)
      RDYG(I)=YG77F1+DCL2*RDX(I)+DCM2*RDY(I)+DCN2*RDZ(I)
      RDZG(I)=ZG77F1+DCL3*RDX(I)+DCM3*RDY(I)+DCN3*RDZ(I)
      TMP(1)=RZERO(I)-DELTA(I)
      TMP(2)=OMET(1,I)*RI(2,2,I)*TMP(1)
      TMP(3)=OMET(1,I)*RI(2,1,I)*TMP(1)
      VTX(I)=RG11*RDXG(I)+RG13*RDZG(I)+TMP(2)
      VTY(I)=RDYG(I)-TMP(3)
      VTZ(I)=RG31*RDXG(I)+RG33*RDZG(I)
C     CALCULATION OF GROUND PLANE FORCES FTRX(I) AND FTRY(I)
      TMP(1)=RG11*RDXG(I)+RG13*RDZG(I)
      VAXLE(I)=SQRT(TMP(1)*TMP(1)+RDYG(I)*RDYG(I))
      IF(CASK(I).GT.1.E-10)GO TO 34
      VGPT(I)=SQRT(VTX(I)*VTX(I)+VTY(I)*VTY(I))
      GO TO 35
 34   TMP(1)=VAXLE(I)+OMET(1,I)*(RZERO(I)-DELTA(I))
      VGPT(I)=ABS(TMP(1))
 35   IF(VGPT(I).LE.VZ)GO TO 40
      PSKD(I)=0.
      IF(ABS(VAXLE(I)).LE.1.E-8)GO TO 42
      PSKD(I)=VGPT(I)/VAXLE(I)
 42   CALL TLU(PSKD(I),LOC(3),MUVP(I))
      FTRX(I)=MUVP(I)*FTRZ(I)/VGPT(I)
      IF(CASK(I).GT.1.E-10)GO TO 50
      TMP(3)=VTY(I)
      GO TO 51
 50   TMP(3)=(VTY(I)+TMP(3))/VAXLE(I)*TMP(1)
 51   FTRY(I)=FTRX(I)*TMP(3)
      IF(CASK(I).GT.1.E-10)GO TO 52
      TMP(2)=VTX(I)
      GO TO 53
 52   TMP(2)=(VTX(I)-TMP(2))/VAXLE(I)*TMP(1)
 53   FTRX(I)=FTRX(I)*TMP(2)
      GO TO 41
 40   FTRX(I)=0.
      FTRY(I)=0.
 41   CONTINUE
C     CALCULATION OF MTRX(I), MTRY(I), AND MTRZ(I)
      DX(I)=RG11*RAX(I)+RG13*RAZ(I)
      DY(I)=RAY(I)
      DZ(I)=RG31*RAX(I)+RG33*RAZ(I)+RZERO(I)-DELTA(I)
      MTRX(I)=DY(I)*FTRZ(I)-DZ(I)*FTRY(I)
      MTRY(I)=DZ(I)*FTRX(I)-DX(I)*FTRZ(I)
      MTRZ(I)=DX(I)*FTRY(I)-DY(I)*FTRX(I)
C     CALCULATION OF FT(I)
      FT(I)=-FTRX(I)*RI(3,1,I)-FTRY(I)*RI(3,2,I)
     C-FTRZ(I)*RI(3,3,I)
C     CALCULATION OF FF(I)
      FDX(I)=RI(1,1,I)*FTRX(I)+RI(1,2,I)*FTRY(I)+RI(1,3,I)*FTRZ(I)
      FDY(I)=RI(2,1,I)*FTRX(I)+RI(2,2,I)*FTRY(I)+RI(2,3,I)*FTRZ(I)
      FF(I)=MUS(I)*SQRT(FDX(I)*FDX(I)+FDY(I)*FDY(I))
C     CALULATION OF GZ(I)
      TMP(3)=-A2(I)/A(I)
      C(I)=0.
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      C2(I)=0.
      IF((SD1(1,I)+TMP(3)*S2D1(1,I)).GE.0.)GO TO 43
      IF(INDC02.EQ.0)GO TO 44
      CALL HIHO(3,LOC(5),NSMAIN,NSTRUT,DU,DU,S(1,I),FI,DU,DU,C(I))
      GO TO 44
 43   IF(INDC01.EQ.0)GO TO 44
      CALL HIHO(3,LOC(4),NSMAIN,NSTRUT,DU,DU,S(1,I),FI,DU,DU,C(I))
 44   IF(S2D1(1,I).GE.0.)GO TO 45
      IF(INDC04.EQ.0)GO TO 46
      CALL HIHO(3,LOC(7),NS2NDY,NSTRUT,DU,DU,S(1,I),FI,DU,DU,C2(I))
      GO TO 46
 45   IF(INDC03.EQ.0)GO TO 46
      CALL HIHO(3,LOC(6),NS2NDY,NSTRUT,DU,DU,S(1,I),FI,DU,DU,C2(I))
 46   GZ(I)=A31(I)*GXB7F+A33(I)*GZB77
C     COMPUTATION OF SR(I)
      TEMP3=0.
      TMP(1)=RX(I)*RI77R-RZ(I)*PI77R
      DO 13 IL3=1,NMODE
      NDO=(IL3-1)*NSTRUT+I
 13   TEMP3=TEMP3+A31(I)*SXMOD(NDO)*GQD2(IL3)+A33(I)*SZMOD(NDO)
     C*GQD2(IL3)
      SR(I)    =A31(I)*FXB7P/AMASS+A33(I)*FZB7P/AMASS
     C+A31(I)*(RZ(I)*QI77R1-RY(I)*RI77R1)+A33(I)
     C*(RY(I)*PI77R1-RX(I)*QI77R1)+A31(I)*(QI77R*
     C(RY(I)*PI77R-RX(I)*QI77R)-RI77R*TMP(1))
     C+A33(I)*(PI77R*TMP(1)-QI77R*(RZ(I)*QI77R
     C-RY(I)*RI77R))+TEMP3
 100  CONTINUE
C         SAVE EPSLON(2) FOR SACS SUBROUTINE
      EPSLO2=EPSLON(2)
      RETURN
      END
      SUBROUTINE FLEX1
C
C    SUBROUTINE FLEX1 EMPLOYS A MATRIX APPROACH TO DETERMINE THE DYNAMIC
C            RESPONSE OF SELECTED POINTS ON A FLEXIBLE AIRPLANE
C
      COMMON/DIRCOM/SKIPUP,DUD(7),AMINER,DM1(13),AA77P,DM2(81),ALA77F,
     *DM3(35),AMA77F,DM4(9),ANA77F,ANA77P,DM5(12),AX77F,DM6,AY77F,
     *DM7(2),AZ77F,DM8(810),YA77P,DM9(183),PI77R,DM10,PI77R1,DM11(5),
     *QI77R,DM12,QI77  ,DM13(5),RI77R,DM14,RI77R1,DM15(15),
     *U777F,DM16(19),V777F,DM17(3),W777F,DM18(93),NSTRUT,
     *MASS(5),RX(5),RY(5),RZ(5),DM19(32),RF(5),DM20(97),SD21(2),
     *SD22(2),SD23(2),SD24(2),SD25(2),DM21(99),IN,DM22(153),
     *INDLG,DM23(151),INDFLX,NMODE,GMASS1(20),GFREQ(20),
     *SXMOD(100),SYMOD(100),SZMOD(100),SKC(5),TXMOD(90),
     *DCMODE(50),APMODE(120),NPTS,OUTMOD(120),ROIS(60),
     *PF(120),GJ(20),GQD1(20),GQD2(20),DDM24(20)
      COMMON/FLXOP/GFORC2(100),GFORC3(100),GFORC4(100),
     *T(5),FCX,FCY,FCZ,XD2F(20),XD2T(20),YD2F(20),YD2T(20),ZD2F(20),
     *ZD2T(20),XD1F(20),XD1T(20),YD1F(20),YD1T(20),ZD1F(20),ZD1T(20),
     *XD0F(20),YD0F(20),ZD0F(20)
      COMMON/LGE/A11(5),A13(5),A31(5),A33(5),DM24(279)
      COMMON/HTCOM/HT,DOMM(2)
      REAL MASS
      DIMENSION GMASS(400),SMASS(25),GSMOD(400),COPHAS(20,20),
     *QS(20),QS1(20),GFORC1(60),DIFF(5),RZA11(25),RXA13(25),RKSY(25),
     *SDD(10),VARY1(3),OMXD1M(5),OMYD1M(5),OMZD1M(5),GF(20),FDC(3),
     *CTMF1(120),GTF(20),SD0(3),SD1(3),SD2(3),TITL(16),LA(40),
     *COEF(20,20)
      EQUIVALENCE (SD21(1),SDD(1))
      DATA HDR/6H  FLEX/,(TITL(I),I=1,16)/5HPOINT,4HXD2F,4HXD2T,4HYD2F,
     *4HYD2T,4HZD2F,4HZD2T,4HXD1F,4HXD1T,4HYD1F,4HYD1T,4HZD1F,
     *4HZD1T,4HXD0F,4HYD0F,4HZD0F/
C PRE DATA INITIALIZATION
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    DO 1 I=1,400
  1 GMASS(I)=0.
    DO 2 I=1,25
    SMASS(I)=0.
    RZA11(I)=0.
    RXA13(I)=0.
  2 RKSY(I)=0.
    DO 15 I=1,40
 15 LA(I)=0
    NMODE=1
    RETURN
C
    ENTRY FLEX2
C
    IF(INDFLX.EQ.0.OR.INDLG.EQ.0)RETURN
    HT=AMINER
    NVAR=2*NMODE
    CALL INUPD(NVAR,LA)
C
C   FORMULATE TIME INVARIANT ARRAYS
C
C   FORM COUPLED GENERALIZED MASS MATRIX
C
C
    DO 30 K=1,NMODE
    NA=(K-1)*NMODE+K
 30 GMASS(NA)=GMASS1(K)
    DO 31 N=1,NSTRUT
    LLA=(N-1)*NSTRUT+N
 31 SMASS(LLA)=MASS(N)
    CALL GTPRD(SXMOD,SMASS,CTMP1,NSTRUT,NMODE,NSTRUT)
    CALL GMPRD(CTMP1,SXMOD,GSMOD,NMODE,NSTRUT,NMODE)
    CALL GMADD(GSMOD,GMASS,GMASS,NMODE,NMODE)
    CALL GTPRD(SYMOD,SMASS,CTMP1,NSTRUT,NMODE,NSTRUT)
    CALL GMPRD(CTMP1,SYMOD,GSMOD,NMODE,NSTRUT,NMODE)
    CALL GMADD(GSMOD,GMASS,GMASS,NMODE,NMODE)
    CALL GTPRD(SZMOD,SMASS,CTMP1,NSTRUT,NMODE,NSTRUT)
    CALL GMPRD(CTMP1,SZMOD,GSMOD,NMODE,NSTRUT,NMODE)
    CALL GMADD(GSMOD,GMASS,GMASS,NMODE,NMODE)
    CALL ARAY(1,NMODE,NMODE,20,20,GMASS,COPMAS)
    CALL DECOMP(NMODE,COPMAS,COEF)
C
C   FORM CONSTANT COMPONETS OF TANGENTIAL ACCELERATION
C
    CALL GTPRD(SXMOD,MASS,QS,NSTRUT,NMODE,1)
    CALL GTPRD(SYMOD,MASS,QS1,NSTRUT,NMODE,1)
    CALL CTIE(QS,QS1,CTMP1,NMODE,1,0,0,1)
    CALL GTPRD(SZMOD,MASS,QS,NSTRUT,NMODE,1)
    CALL CTIE(CTMP1,QS,GFORC1,NMODE,2,0,0,1)
    DO 33 L=1,NSTRUT
    DIFF(L)=RF(L)-SKC(L)
    MA=(L-1)*NSTRUT+L
    RZA11(MA)=RZ(L)+DIFF(L)*A11(L)
    RXA13(MA)=RX(L)-DIFF(L)*A13(L)
 33 RKSY(MA)=RY(L)
    CALL GTPRD(SZMOD,RKSY,CTMP1,NSTRUT,NMODE,NSTRUT)
    CALL GTPRD(SYMOD,RZA11,GSMOD,NSTRUT,NMODE,NSTRUT)
    CALL GMSUB(CTMP1,GSMOD,GFORC2,NMODE,NSTRUT)
    CALL GTPRD(SXMOD,RZA11,CTMP1,NSTRUT,NMODE,NSTRUT)
    CALL GTPRD(SZMOD,RXA13,GSMOD,NSTRUT,NMODE,NSTRUT)
    CALL GMSUB(CTMP1,GSMOD,GFORC3,NMODE,NSTRUT)
    CALL GTPRD(SYMOD,RXA13,CTMP1,NSTRUT,NMODE,NSTRUT)
    CALL GTPRD(SXMOD,RKSY,GSMOD,NSTRUT,NMODE,NSTRUT)
    CALL GMSUB(CTMP1,GSMOD,GFORC4,NMODE,NSTRUT)
C
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C
C  FORM INITIAL DISPLACEMENTS
C
      SUM1=0.
      SUM3=0.
      DO 34 I=1,NSTRUT
      SUM1=SUM1+A31(I)*SDD((I-1)*2+1)
   34 SUM3=SUM3+A33(I)*SDD((I-1)*2+1)
      VARY1(1)=AX77F-SUM1
      VARY1(2)=AY77F
      VARY1(3)=AZ77F-SUM3
      CALL GMPRD(GFORC1,VARY1,QS,NMODE,3,1)
      DO 35 I=1,NSTRUT
      OMXD1M(I)=PI77R1*MASS(I)
      OMYD1M(I)=QI77R1*MASS(I)
   35 OMZD1M(I)=RI77R1*MASS(I)
      CALL GMPRD(GFORC2,OMXD1M,GF,NMODE,NSTRUT,1)
      CALL GMADD(QS,GF,QS,NMODE,1)
      CALL GMPRD(GFORC3,OMYD1M,GF,NMODE,NSTRUT,1)
      CALL GMADD(QS,GF,QS,NMODE,1)
      CALL GMPRD(GFORC4,OMZD1M,GF,NMODE,NSTRUT,1)
      CALL GMADD(QS,GF,QS,NMODE,1)
      CALL GTPRD(TXMCO,T,GF,IN,NMODE,1)
      CALL GMSUB(GF,QS,QS,NMODE,1)
      FDC(1)=FCX
      FDC(2)=FCY
      FDC(3)=FCZ
      CALL GTPRD(DCMODE,FDC,GF,3,NMODE,1)
      CALL GMADD(GF,QS,QS,NMODE,1)
      DO 36 I=1,NMODE
      NN=(I-1)*6+1
      CTMP1(NN)=-ARMODE(NN)*AA77P
      CTMP1(NN+1)=ARMODE(NN+1)*YA77P
      CTMP1(NN+2)=-ARMODE(NN+2)*ANA77P
      CTMP1(NN+3)=ARMODE(NN+3)*ALA77F
      CTMP1(NN+4)=ARMODE(NN+4)*AMA77F
   36 CTMP1(NN+5)=ARMODE(NN+5)*ANAZ7F
      DO 37 II=1,NMODE
      GF(II)=0.
      DO 37 JJ=1,6
      MJ=(II-1)*6+JJ
   37 GF(II)=GF(II)+CTMP1(MJ)*PF(MJ)
      CALL GMADD(GF,QS,QS,NMODE,1)
      DO 38 IG=1,NMODE
      GTF(IG)=GMASS1(IG)*GFREQ(IG)**2.
   38 GQ(IG)=QS(IG)/GTF(IG)
      SKIPUP=.TRUE.
      DO 39 I=1,NMODE
      N22=2*I
      CALL UPDAT(1,LA(N22),GQ(I),DU,DU,DU,DU)
   39 CONTINUE
      SKIPUP=.FALSE.
      RETURN
C
      ENTRY FLEX3
C
      IF(INDFLX.EQ.0.OR.INDLG.EQ.0)RETURN
C
C  FORM VARYING COMPONETS OF TANGENTIAL ACCELERATION
C
      SUM1=0.
      SUM3=0.
      DO 40 I= 1,NSTRUT
      SUM1=SUM1+A31(I)*SDD((I-1)*2+1)
   40 SUM3=SUM3+A33(I)*SDD((I-1)*2+1)
      VARY1(1)=AX77F-SUM1
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      VARY1(2)=AY77F
      VARY1(3)=AZ77F-SUM3
      CALL GMPRD(GFORC1,VARY1,GTF,NMODE,3,1)
      DO 46 I=1,NMODE
   46 QS(I)=0.
      CALL GMSUB(QS,GTF,QS,NMODE,1)
      DO 41 I=1,NSTRUT
      OMXD1M(I)=PI77R1*MASS(I)
      OMYD1M(I)=QI77R1*MASS(I)
   41 OMZD1M(I)=RI77R1*MASS(I)
C
      CALL GMPRD(GFORC2,OMXD1M,GTF,NMODE,NSTRUT,1)
      CALL GMSUB(QS,GTF,QS,NMODE,1)
      CALL GMPRD(GFORC3,OMYD1M,GTF,NMODE,NSTRUT,1)
      CALL GMSUB(QS,GTF,QS,NMODE,1)
      CALL GMPRD(GFORC4,OMZD1M,GTF,NMODE,NSTRUT,1)
      CALL GMSUB(QS,GTF,QS,NMODE,1)
C
C     FORM GENERALIZED THRUST MATRIX
C
      CALL GTPRD(TXMOD,T,GTF,IN,NMODE,1)
      CALL GMADD(QS,GTF,QS,NMODE,1)
C
C     FORM GENERALIZED DRAG CHUTE FORCES
C
      FDC(1)=FCX
      FDC(2)=FCY
      FDC(3)=FCZ
      CALL GTPRD(DCMODE,FDC,GTF,3,NMODE,1)
      CALL GMADD(QS,GTF,QS,NMODE,1)
C
C     FORM GENERALIZED AERO FORCES
C
      DO 42 I=1,NMODE
      NN=(I-1)*6+1
      CTMP1(NN)=-ARMODE(NN)*AA77P
      CTMP1(NN+1)=ARMODE(NN+1)*YA77P
      CTMP1(NN+2)=-ARMODE(NN+2)*ANA77P
      CTMP1(NN+3)=ARMODE(NN+3)*ALA77F
      CTMP1(NN+4)=ARMODE(NN+4)*AMA77F
   42 CTMP1(NN+5)=ARMODE(NN+5)*ANAZ7F
      DO 43 II=1,NMODE
      GTF(II)=0.
      DO 43 JJ=1,6
      MJ=(II-1)*6+JJ
   43 GTF(II)=GTF(II)+CTMP1(MJ)*PF(MJ)
      CALL GMADD(QS,GTF,QS,NMODE,1)
C
C     FORM GENERALIZED STIFFNESS
C
      DO 44 IG=1,NMODE
      GTF(IG)=GQ(IG)*GMASS1(IG)*GFREQ(IG)**2.
   44 QS(IG)=QS(IG)-GTF(IG)
C
C     SOLVE FOR THE GENERALIZED ACCELERATION
C
      CALL SOLVE(NMODE,COEF,QS,GQD2)
      DO 45 I=1,NMODE
      NCON=(I-1)*2+1
      MCON=NCON+1
      CALL INTEG(LA(NCON),GQD2(I))
      CALL INTEG(LA(MCON),GQD1(I))
   45 CONTINUE
      RETURN
C
```

```
      ENTRY FLEX4
C
      RETURN
C
      ENTRY FLEX5
C
      RETURN
C
      ENTRY FLEX6
C
      IF(INDFLX.EQ.0.OR.INDLG.EQ.0)RETURN
      IF (NPTS.EQ.0) RETURN
C
C   FORM VARIABLES TO BE OUTPUT
C
      CALL STFL(0,1,HDR)
      CALL STFL(2,16,TITL)
      DO 62 I=1,NPTS
      DO 61 K=1,3
      SD0(K)=0.
      SD1(K)=0.
      SD2(K)=0.
      DO 61 J=1,NMODE
      NCON=((I-1)*3+K-1)*NMODE+J
      SD0(K)=SD0(K)+OUTMOD(NCON)*GQ(J)
      SD1(K)=SD1(K)+OUTMOD(NCON)*GQD1(J)
   61 SD2(K)=SD2(K)+OUTMOD(NCON)*GQD2(J)
      LX=(I-1)*3+1
      LY=LX+1
      LZ=LY+1
      XD2F(I)=SD2(1)
      XD2T(I)=AX77F+XD2F(I)+2.*(QI77R*SD1(3)-RI77R*SD1(2))+
     *(PI77R*RI77R+QI77R1)*(ROIS(LZ)+SD0(3))+(PI77R*QI77R
     *-RI77R1)*(ROIS(LY)+SD0(2))-(QI77R*QI77R+RI77R*RI77R)
     * *(ROIS(LX)+SD0(1))
      YD2F(I)=SD2(2)
      YD2T(I)=AY77F+YD2F(I)+2.*(RI77R*SD1(1)-PI77R*SD1(3))+
     *(QI77R*PI77R+RI77R1)*(ROIS(LX)+SD0(1))+(QI77R*RI77R
     *-PI77R1)*(ROIS(LZ)+SD0(3))-(RI77R*RI77R+PI77R*PI77R)
     * *(ROIS(LY)+SD0(2))
      ZD2F(I)=SD2(3)
      ZD2T(I)=AZ77F+ZD2F(I)+2.*(PI77R*SD1(2)-QI77R*SD1(1))+
     *(RI77R*QI77R+PI77R1)*(ROIS(LY)+SD0(2))+(RI77R*PI77R
     *-QI77R1)*(ROIS(LX)+SD0(1))-(PI77R*PI77R+QI77R*QI77R)
     * *(ROIS(LZ)+SD0(3))
      XD1F(I)=SD1(1)
      XD1T(I)=U777F+XD1F(I)+QI77R*(ROIS(LZ)+SD0(3))-RI77R*
     *(ROIS(LY)+SD0(2))
      YD1F(I)=SD1(2)
      YD1T(I)=V777F+YD1F(I)+RI77R*(ROIS(LX)+SD0(1))-PI77R*
     *(ROIS(LZ)+SD0(3))
      ZD1F(I)=SD1(3)
      ZD1T(I)=W777F+ZD1F(I)+PI77R*(ROIS(LY)+SD0(2))-QI77R*
     *(ROIS(LX)+SD0(1))
      XD0F(I)=SD0(1)
      YD0F(I)=SD0(2)
      ZD0F(I)=SD0(3)
      PTN=FLOAT(I)
      CALL STOVAR(8,PTN,XD2F(I),XD2T(I),YD2F(I),YD2T(I),ZD2F(I),
     *ZD2T(I),XD1F(I))
      CALL STOVAR(8,XD1T(I),YD1F(I),YD1T(I),ZD1F(I),ZD1T(I),XD0F(I),
     *YD0F(I),ZD0F(I))
   62 CONTINUE
      RETURN
C
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C     ENTRY FLEX7
      IF(INDFLX.EQ.0.OR.INDLG.EQ.0) RETURN
      RVAR=2.*FLOAT(NMODE)/4.
      K=IFIX(RVAR)
      IF (K.EQ.0) GO TO 71
      DO 70 I=1,K
      N=4*I-3
      MD1=2*I-1
      MD0=2*I
      CALL UPDAT(4,LA(N),GQD1(MD1),GQ(MD1),GQD1(MD0),GQ(MD0),DU)
   70 CONTINUE
      L=2*K
      IF(L.EQ.NMODE) RETURN
   71 M=4*K+1
      MP=2*K+1
      CALL UPDAT(2,LA(M),GQD1(MP),GQ(MP),DU,DU,DU)
      RETURN
      END
      SUBROUTINE DECOMP (NN,A,UL)
      DIMENSION A(20,20), UL(20,20), SCALES(20), IPS(20)
      COMMON IPS
      IF (NN.GT.1) GO TO 20
      UL(1,1)=A(1,1)
      RETURN
   20 N=NN
C
C     INITIALIZE IPS, UL AND SCALES
      DO 5 I=1,N
      IPS(I)=I
      ROWNRM=0.0
      DO 2 J=1,N
      UL(I,J)=A(I,J)
      IF (ROWNRM-ABS(UL(I,J))) 1,2,2
    1 ROWNRM=ABS(UL(I,J))
    2 CONTINUE
      IF (ROWNRM) 3,4,3
    3 SCALES(I)=1.0/ROWNRM
      GO TO 5
    4 CALL SING(1)
      SCALES(I)=0.0
    5 CONTINUE
C
C     GAUSSIAN ELIMINATION WITH PARTIAL PIVOTING
      NM1=N-1
      DO 17 K=1,NM1
      BIG=0.0
      DO 11 I=K,N
      IP=IPS(I)
      SIZE=ABS(UL(IP,K))*SCALES(IP)
      IF (SIZE-BIG) 11,11,10
   10 BIG=SIZE
      IDXPIV=I
   11 CONTINUE
      IF (BIG) 13,12,13
   12 CALL SING(2)
      GO TO 17
   13 IF (IDXPIV-K) 14,15,14
   14 J=IPS(K)
      IPS(K)=IPS(IDXPIV)
      IPS(IDXPIV)=J
   15 KP=IPS(K)
      PIVOT=UL(KP,K)
      KP1=K+1
      DO 16 I=KP1,N
```

```
      IP=IPS(I)
      EM=-UL(IP,K)/PIVOT
      UL(IP,K)=-EM
      DO 16 J=KP1,N
      UL(IP,J)=UL(IP,J)+EM*UL(KP,J)
   16 CONTINUE
   17 CONTINUE
      KP=IPS(N)
      IF (UL(KP,N)) 19,18,19
   18 CALL SING(2)
   19 RETURN
      END
      SUBROUTINE SOLVE (NN,UL,B,X)
      DIMENSION UL(20,20), B(20), X(20), IPS(20)
      COMMON IPS
      IF (NN.GT.1) GO TO 5
      X(1)=B(1)/UL(1,1)
      RETURN
    5 N=NN
      NP1=N+1
C
      IP=IPS(1)
      X(1)=B(IP)
      DO 2 I=2,N
      IP=IPS(I)
      IM1=I-1
      SUM=0.0
      DO 1 J=1,IM1
    1 SUM=SUM+UL(IP,J)*X(J)
    2 X(I)=B(IP)-SUM
C
      IP=IPS(N)
      X(N)=X(N)/UL(IP,N)
      DO 4 IBACK=2,N
      I=NP1-IBACK
C       I GOES (N-1),.....,1
      IP=IPS(I)
      IP1=I+1
      SUM=0.0
      DO 3 J=IP1,N
    3 SUM=SUM+UL(IP,J)*X(J)
    4 X(I)=(X(I)-SUM)/UL(IP,I)
      RETURN
      END
      SUBROUTINE SING (IWHY)
   11 FORMAT(54H MATRIX WITH ZERO ROW IN DECOMPOSE.                   )
   12 FORMAT(54H SINGULAR MATRIX IN DECOMPOSE. ZERO DIVIDE IN SOLVE.   )
      NOUT=6
C       NOUT=STANDARD OUTPUT UNIT
      GO TO (1,2),IWHY
    1 WRITE (NOUT,11)
      GO TO 10
    2 WRITE (NOUT,12)
   10 CALL EXERR(0)
      RETURN
      END
      SUBROUTINE ARAY (MODE,I,J,N,M,S,D)
C           IDENT   ARAY
C           TITLE   ARAY
***          ADAPTED FROM S/360 SCIENTIFIC SUBROUTINE PACKAGE.
*             (360A-CM-03X) VERSION III
*             R. A. GARMOE.    08/16/69.
***
*     ..................................................................
*
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```
*      SUBROUTINE ARAY
*
*      PURPOSE
*         CONVERT DATA ARAY FROM SINGLE TO DOUBLE DIMENSION OR VICE
*            VERSA.  THIS SUBROUTINE IS USED TO LINK THE USER PROGRAM
*            WHICH HAS DOUBLE DIMENSION ARAYS AND THE SSP SUBROUTINES
*            WHICH OPERATE ON ARAYS OF DATA IN A VECTOR FASHION.
*
*     ..................................................................
*
      DIMENSION S(1),D(1)
      IF (I.GT.1) GO TO 98
      IF (MODE.EQ.1) D(1)=S(1)
      IF (MODE.EQ.2) S(1)=D(1)
      RETURN
*
   98 NI=N-I
*
*
*        TEST TYPE OF CONVERSION
*
      IF(MODE-1) 100, 100, 120
*
*        CONVERT FROM SINGLE TO DOUBLE DIMENSION
*
  100 IJ=I*J+1
      NM=N*J+1
      DO 110 K=1,J
      NM=NM-NI
      DO 110 L=1,I
      IJ=IJ-1
      NM=NM-1
  110 D(NM)=S(IJ)
      GO TO 140
*
*        CONVERT FROM DOUBLE TO SINGLE DIMENSION
*
  120 IJ=0
      NM=0
      DO 130 K=1,J
      DO 125 L=1,I
      IJ=IJ+1
      NM=NM+1
  125 S(IJ)=D(NM)
  130 NM=NM+NI
*
  140 RETURN
      END
      SUBROUTINE CTIE(A,B,R,N,M,MSA,MSB,L)
C           IDENT   CTIE
C           TITLE   CTIE
***        ADAPTED FROM S/360 SCIENTIFIC SUBROUTINE PACKAGE.
*          (360A-CM-03X) VERSION III
*          R. A. GARMOE.    08/16/69.
***
*     ..................................................................
*
*        SUBROUTINE CTIE
*
*        PURPOSE
*           ADJOIN TWO MATRICES WITH SAME ROW DIMENSION TO FORM ONE
*              RESULTANT MATRIX (SEE METHOD)
*
*     ..................................................................
*
```

```
*  I  DIMENSION A(1),B(1),R(1)
      MM=M
      IR=0
      MSX=MSA
      DO 6 JJ=1,2
      DO 5 J=1,MM
      DO 5 I=1,N
      IR=IR+1
      R(IR)=0.0
*
*        LOCATE ELEMENT FOR ANY MATRIX STORAGE MODE
*
      CALL LOC(I,J,IJ,N,MM,MSX)
*
*        TEST FOR ZERO ELEMENT IN DIAGONAL MATRIX
*
      IF(IJ) 2,5,2
*
*        MOVE ELEMENT TO MATRIX R
*
    2 GO TO(3,4),JJ
    3 R(IR)=A(IJ)
      GO TO 5
    4 R(IR)=B(IJ)
    5 CONTINUE
*
*        REPEAT ABOVE FOR MATRIX B
*
      MSX=MSB
      MM=L
    6 CONTINUE
      RETURN
      END
      SUBROUTINE LOC(I,J,IR,N,M,MS)
C           IDENT   LOC
C           TITLE   LOC
***.         ADAPTED FROM S/360 SCIENTIFIC SUBROUTINE PACKAGE.
*             (360A-CM-03X) VERSION III
*             R. A. GARMOE.   08/16/69.
***
*     ..................................................................
*
*        SUBROUTINE LOC
*
*        PURPOSE
*           COMPUTE A VECTOR SUBSCRIPT FOR AN ELEMENT IN A MATRIX OF
*           SPECIFIED STORAGE MODE
*
*     ..................................................................
*
      IX=I
      JX=J
      IF(MS-1) 10,20,30
   10 IRX=N*(JX-1)+IX
      GO TO 36
   20 IF(IX-JX) 22,24,24
   22 IRX=IX+(JX*JX-JX)/2
      GO TO 36
   24 IRX=JX+(IX*IX-IX)/2
      GO TO 36
   30 IRX=0
```

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```
      IF(IX-JX) 36,32,36
   32 IRX=IX
   36 IR=IRX
      RETURN
      END
      SUBROUTINE GTPRD(A,B,R,N,M,L)
C          IDENT   GTPRD
C          TITLE   GTPRD
***        ADAPTED FROM S/360 SCIENTIFIC SUBROUTINE PACKAGE.
*           (360A-CM-03X) VERSION III
*           R. A. GARMOE.    08/16/69.
***
*
*     ..................................................................
*
*        SUBROUTINE GTPRD
*
*        PURPOSE
*           PREMULTIPLY A GENERAL MATRIX BY THE TRANSPOSE OF ANOTHER
*           GENERAL MATRIX
*
*     ..................................................................
*
      DIMENSION A(1),B(1),R(1)
*
      IR=0
      IK=-N
      DO 10 K=1,L
      IJ=0
      IK=IK+N
      DO 10 J=1,M
      IB=IK
      IR=IR+1
      R(IR)=0
      DO 10 I=1,N
      IJ=IJ+1
      IB=IB+1
   10 R(IR)=R(IR)+A(IJ)*B(IB)
      RETURN
      END
      SUBROUTINE GMSUB(A,B,R,N,M)
C          IDENT   GMSUB
C          TITLE   GMSUB
***        ADAPTED FROM S/360 SCIENTIFIC SUBROUTINE PACKAGE.
*           (360A-CM-03X) VERSION III
*           R. A. GARMOE.    08/16/69.
***
*
*     ..................................................................
*
*        SUBROUTINE GMSUB
*
*        PURPOSE
*           SUBTRACT ONE GENERAL MATRIX FROM ANOTHER TO FORM RESULTANT
*           MATRIX
*
*     ..................................................................
*
      DIMENSION A(1),B(1),R(1)
*
*        CALCULATE NUMBER OF ELEMENTS
*
      NM=N*M
*
*        SUBTRACT MATRICES
*
      DO 10 I=1,NM
```

```
   10 R(I)=A(I)-B(I)
      RETURN
      END
      SUBROUTINE GMADD(A,B,R,N,M)
C           IDENT   GMADD
C           TITLE   GMADD
***        ADAPTED FROM S/360 SCIENTIFIC SUBROUTINE PACKAGE.
*           (360A-CM-03X) VERSION III
*           R. A. GARMOE.    08/16/69.
***
*     ..................................................................
*
*        SUBROUTINE GMADD
*
*        PURPOSE
*           ADD TWO GENERAL MATRICES TO FORM RESULTANT GENERAL MATRIX
*
*     ..................................................................
*
      DIMENSION A(1),B(1),R(1)
*
*        CALCULATE NUMBER OF ELEMENTS
*
      NM=N*M
*
*        ADD MATRICES
*
      DO 10 I=1,NM
   10 R(I)=A(I)+B(I)
      RETURN
      END
      SUBROUTINE GMPRD(A,B,R,N,M,L)
C           IDENT   GMPRD
C           TITLE   GMPRD
***        ADAPTED FROM S/360 SCIENTIFIC SUBROUTINE PACKAGE.
*           (360A-CM-03X) VERSION III
*           R. A. GARMOE.    08/16/69.
***
*     ..................................................................
*
*        SUBROUTINE GMPRD
*
*        PURPOSE
*           MULTIPLY TWO GENERAL MATRICES TO FORM A RESULTANT GENERAL
*           MATRIX
*
*     ..................................................................
*
      DIMENSION A(1),B(1),R(1)
*
      IR=0
      IK=-M
      DO 10 K=1,L
      IK=IK+M
      DO 10 J=1,N
      IR=IR+1
      JI=J-N
      IB=IK
      R(IR)=0
      DO 10 I=1,M
      JI=JI+N
      IB=IB+1
   10 R(IR)=R(IR)+A(JI)*B(IB)
      RETURN
      END
```

```
      SUBROUTINE SDFLGP
      COMMON/DIRCOM/DM1(74),TIMER,DM2(61),AMASS,DM20(27),AX77F,DM21(4),
     *AZ77F,DM22(114),DCL1,DCM1,
     *DCN1,DCL2,DCM2,DCN2,DCL3,DCM3,DCN3,DM3(99),FXB7P,
     *DUM4(3),FYB7P,DM23(3),FZB7P,DM5(17),GXB7F,DM6(8),
     *GZB7F,DM24(6),HGC7F,DM25(211),INDSTE,DM12(47),PHIPD,DM26(23),
     *PSIPD,
     *DM27(156),THTPD,DM28(5),TIME,DM29(12),TMAX,DM8(274),
     *PI77R,DM30,PI77R1,DM9(5),QI77R,DM31,QI77R1,DM10(5),
     *RI77R,DM32,RI77R1,DM11(49),XG77F,DM33,XG77F1,
     *DM34(11),YG77F,DM35,YG77F1,DM36(11),
     *ZG77F,DM37,ZG77F1,DUM13(53),
     CNSTRUT,MASS(5),RX(5),RY(5),RZ(5),THETAD(5),ERDEG,RGR,
     CNTIRES(5),RZERO(5),H(5),DELTAM(5),MOMENT(5),
     CRF(5),VZ   ,IFD,PZERO(5),VZERO(5),A(5),P22(5),V20(5),
     CA2(5),IL,S2T(5),ES2(5),C2L(5),MASS2(5),MUS(5),
     CCC(5),CE(5),C2C(5),C2E(5),NVGPT,NPP,MB(5),RLT,NDELTA,
     CE3(5),SB(5),SD21(2),SD22(2),SD23(2),SD24(2),SD25(2)
      COMMON/DIRCOM/
     CSD11(2),SD12(2),SD13(2),SD14(2),SD15(2),
     CS1(2),SS2(2),S3(2),S4(2),S5(2),
     CS2D21(2),S2D22(2),S2D23(2),S2D24(2),S2D25(2),
     CS2D11(2),S2D12(2),S2D13(2),S2D14(2),S2D15(2),
     CS21(2),S22(2),S23(2),S24(2),S25(2),
     COMTD11(2),OMTD12(2),OMTD13(2),OMTD14(2),OMTD15(2),
     COMT1(2),OMT2(2),OMT3(2),OMT4(2),OMT5(2),
     CAI(5),BI(5),DELTA1,DELTA2,DELTA3,DELTA4,DELTA5,
     CDDELT1,DDELT2,DDELT3,DDELT4,DDELT5,ISTAGE,
     CPRTMIN,IPL1,ISDF,ISTPL1,ISTPL2,ISTPL3,ISTPL4,ISTPL5,
     CDM14(154),INDLG,DM15(151),DM16(607),NPTS,DPM17(1440),IFLX(20)
      COMMON/FLXDP/DOM17(319),XD2F(20),XD2T(20),YD2F(20),YD2T(20),
     *ZD2F(20),ZD2T(20),XD1F(20),XD1T(20),YD1F(20),YD1T(20),
     *ZD1F(20),ZD1T(20),XD0F(20),YD0F(20),ZD0F(20)
      REAL MASS,MOMENT,    MASS2,MUS,NTIRES,MB
      COMMON/LGDE/LA(25),FC2(5),P2(5),PRES(5),C(5),IPPT,LTPT
      COMMON/LG/FXM,FYM,FZM,LM,MM,NM
      COMMON/LGC/A11(5),A13(5),A31(5),A33(5),RRCGX(5),
     CRL(3,3),RI(3,3,5),RAX(5),RAY(5),RAZ(5),TMP(3),ZZERO(5),
     CXR(5),YR(5),EPSLON(5),PA(5),FDELTA(5),
     CFTRZ(5),RDX(5),RDY(5),RDZ(5),RDXG(5),RDYG(5),RDZG(5),
     CVTX(5),VTY(5),VTZ(5),GZ(5),       VGPT(5),FTRX(5),FTRY(5),
     CDX(5),DY(5),DZ(5),FT(5),FDX(5),FDY(5),FF(5),AA(5),C2(5),
     CSR(5),SF(5),PSKD(5),MUVP(5),MTRX(5),MTRY(5),
     CMTRZ(5),MA(5),RG11,RG13,RG31,RG33,IPRT,
     CMTX,MTY,MTZ,SFTRX,SFTRY,SFTRZ,FTRA,
     CFTRB,FTRC,SMTRX,SMTRY,SMTRZ
      REAL MUVP,MTRX,MTRY,MTRZ,MA,
     CMTX,MTY,MTZ,LM,MM,NM
      DIMENSION DELTA(5),DDELTA(5),P(5),
     C       SD2(2,5),SD1(2,5),S(2,5),S2D2(2,5),S2D1(2,5),S2(2,5),
     COMETD1(2,5),OMET(2,5)
      EQUIVALENCE (P(1),PRES(1))
      EQUIVALENCE (DELTA(1),DELTA1),(DDELTA(1),DDELT1)
      EQUIVALENCE
     C(SD21(1),SD2(1,1)),(SD11(1),SD1(1,1)),(S1(1),S(1,1)),
     C(S2D21(1),S2D2(1,1)),(S2D11(1),S2D1(1,1)),(S21(1),S2(1,1)),
     C(OMTD11(1),OMETD1(1,1)),(OMT1(1),OMET(1,1))
      DIMENSION OP16(8),OP17(8),OP18(8),OP19(4),OP20(8),OP21(8),
     *DAT2(15),DAT3(6),DAT4(15)
      DATA
     *(OP16(I),I=1,8)/5HDELTA,1HP,2HP2,2HFT,2HSR,2HSF,2HAA,3HFC2/,
     *(OP17(I),I=1,8)/3HSD2,3HSD1,1HS,4HS2D2,4HS2D1,2HS2,
     *6HOMETD1,4HOMET/,
     *(OP18(I),I=1,8)/4HFTRA,4HFTRB,4HFTRC,3HMTX,3HMTY,
     *3HMTZ,3HFXM,3HFYM/,
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     *(OP19(I),I=1,4)/3HFZM,2HLM,2HMM,2HNM/,
     *(OP20(I),I=1,8)/4HMOVP,4HVGPT,4HFTRX,4HFTRY,4HFTRZ,
     *2HMA,2HMB,6HCDELTA/,
     *(OP21(I),I=1,8)/5HDELTA,2HFT,4HMUVP,4HFTRX,4HFTRY,
     *4HFTPZ,6HDDELTA,1HS/
      DATA HBCI/6HLGEAR /
      DATA DAT1/4HTIME/,(DAT2(I),I=1,15)/2HLM,2HMM,2HNM,5HQI77R,
     *5HTHIPD,5HPSIPD,5HPHIPD,3HFZM,5HAZ77F,6HZG77F1,5HHGC7F,
     *5HXG77F,5HYG77F,5HAX77F,6HXG77F1/,
     *(DAT3(I),I=1,6)/2HFT,2HSF,5HDELTA,1HP,2HP2,2HMA/,
     *(DAT4(I),I=1,15)/4HXD2F,4HXD2T,4HYD2F,4HYD2T,4HZD2F,4HZD2T,
     *4HXD1F,4HXD1T,4HYD1F,4HYD1T,4HZD1F,4HZD1T,4HXD0F,4HYD0F,4HZD0F/
      DATA DAT5/6HLASTPT/,N1/1/,N15/15/,N14/14/
C     SAVE DATA ON TAPE
      IF(IPLT.EQ.0)RETURN
      LASTPT=0
      IF(IPLT.GT.1) GO TO 201
      NHL=2
      IF(ISDF.NE.0)NHL=NHL+1
      ISUM1=ISTPL1+ISTPL2+ISTPL3 +ISTPL4+ISTPL5
      IF(ISUM1.NE.0)NHL=NHL+1
      ISUM2=0
      DO 105 I=1,NPTS
  105 ISUM2=ISUM2+IFLX(I)
      IF(ISUM2.NE.0)NHL=NHL+1
      WRITE(13)NHL
      WRITE(13)N1,N1,DAT1
      IF(ISDF.NE.0) WRITE(13)N15,N1,DAT2
      IF(ISUM1.NE.0)WRITE(13)N14,ISUM1,DAT3,OP17
      IF(ISUM2.NE.0)WRITE(13)N15,ISUM2,DAT4
      WRITE(13)N1,N1,DAT5
      IPLT=IPLT+1
  201 WRITE(13) TIME
      IF(ISDF.NE.0) WRITE(13) LM,MM,NM,QI77R,THTPD,PSIPD,PHIPD,FZM,
     *AZ77F,ZG77F1,HGC7F,XG77F,YG77F,AX77F,XG77F1
      IF(ISTPL1.NE.0) WRITE(13) FT(1),SF(1),DELTA(1),P(1),P2(1),MA(1),
     *SD2(1,1),SD1(1,1),S(1,1),S2D2(1,1),S2D1(1,1),S2(1,1),OMETD1(1,1),
     *OMET(1,1)
      IF(ISTPL2.NE.0) WRITE(13) FT(2),SF(2),DELTA(2),P(2),P2(2),MA(2),
     *SD2(1,2),SD1(1,2),S(1,2),S2D2(1,2),S2D1(1,2),S2(1,2),OMETD1(1,2),
     *OMET(1,2)
      IF(ISTPL3.NE.0) WRITE(13) FT(3),SF(3),DELTA(3),P(3),P2(3),MA(3),
     *SD2(1,3),SD1(1,3),S(1,3),S2D2(1,3),S2D1(1,3),S2(1,3),OMETD1(1,3),
     *OMET(1,3)
      IF(ISTPL4.NE.0) WRITE(13) FT(4),SF(4),DELTA(4),P(4),P2(4),MA(4),
     *SD2(1,4),SD1(1,4),S(1,4),S2D2(1,4),S2D1(1,4),S2(1,4),OMETD1(1,4),
     *OMET(1,4)
      IF(ISTPL5.NE.0) WRITE(13) FT(5),SF(5),DELTA(5),P(5),P2(5),MA(5),
     *SD2(1,5),SD1(1,5),S(1,5),S2D2(1,5),S2D1(1,5),S2(1,5),OMETD1(1,5),
     *OMET(1,5)
      DO 17 I=1,NPTS
      IF(IFLX(I).NE.0) WRITE(13) XD2F(I),XD2T(I),YD2F(I),YD2T(I),
     *ZD2F(I),ZD2T(I),XD1F(I),XD1T(I),YD1F(I),YD1T(I),ZD1F(I),ZD1T(I),
     *XD0F(I),YD0F(I),ZD0F(I)
   17 CONTINUE
      GO TO 24
      ENTRY LGEAR5
      IF(IPLT.EQ.0)RETURN
      IF(LTPT.EQ.0)RETURN
      LTPT=0
      LASTPT=1
      BACKSPACE 13
   24 WRITE(13)LASTPT
      IF(LASTPT.EQ.0)RETURN
      END FILE 13
      RETURN
      ENTRY LGEAR6
C     TIME HISTORY PRINT
      IF(INDLG.EQ.1)RETURN
C     CALL STFL(3,1,HBCI)
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      IF(INDLG.EQ.2)GO TO 30
      CALL STFL(2,8,OP16)
      DO 121 I=1,NSTRUT
      CALL STOVAR(8,DELTA(I),P(I),P2(I),FT(I),SR(I),SF(I),AA(I),FC2(I))
121   CONTINUE
      CALL STFL(2,8,OP20)
      DO 123 I=1,NSTRUT
      CALL STOVAR(8,MUVP(I),VGPT(I),FTRX(I),FTRY(I),FTRZ(I),
     *MA(I),MB(I),DDELTA(I))
123   CONTINUE
      CALL STFL(2,8,OP17)
      DO 122 I=1,NSTRUT
      CALL STOVAR(8,SD2(1,I),SD1(1,I),S(1,I),S2D2(1,I),
     CS2D1(1,I),S2(1,I),OMETD1(1,I),OMET(1,I))
122   CONTINUE
      GO TO 32
30    CALL STFL(2,8,OP21)
      DO 31 I=1,NSTRUT
      CALL STOVAR(8,DELTA(I),FT(I),MUVP(I),FTRX(I),FTRY(I),
     CFTRZ(I),DDELTA(I),S(1,I))
31    CONTINUE
32    CALL STFL(2,8,OP18)
      CALL STOVAR(8,FTRA,FTRB,FTRC,MTX,MTY,MTZ,
     CFXM,FYM)
      CALL STFL(2,4,OP19)
      CALL STOVAR(4,FZM,LM,MM,NM,DU,DU,DU,DU)
      RETURN
C     **********
      ENTRY LGEAR5
C     **********
C     COMPUTE AND PRINT CODES
      RETURN
C
      ENTRY LGEAR7
C
      IF(INDLG.EQ.0)RETURN
      IF(INDLG.EQ.2)RETURN
      DO 6 I=1,NSTRUT
      IF(IL.NE.3)GO TO 5
      I1=2*I+3*NSTRUT-1
      CALL UPDAT(2,LA(I1),S2D1(1,I),S2(1,I),DU,DU,DU)
5     I1=2*I+NSTRUT-1
      CALL UPDAT(2,LA(I1),SD1(1,I),S(1,I),DU,DU,DU)
      CALL UPDAT(1,LA(I),OMET(1,I),DU,DU,DU,DU)
6     CONTINUE
      RETURN
      END
      OVERLAY(TOLA,1,0)
      PROGRAM TOLAN1
      COMMON/CONTRO/ICONTR,CONTR1,ICONT2,ICONT3
      IF(ICONTR-2)1,2,3
1     CALL READ
      GO TO 19
2     CALL TFFS2
      GO TO 19
3     IF(ICONTR-4)4,5,6
4     CALL SAC32
      GO TO 19
5     CALL VPCTAB
      GO TO 19
6     IF(ICONTR-6)7,8,9
7     CALL OPTTAB
      GO TO 19
8     CALL LGTAB
      GO TO 19
```

```
      CALL DSERCH(CONTR1,ICONT2,ICONT3)
 19   CONTINUE
      END
      SUBROUTINE TFFS2
      COMMON/TABSRC/LOCTFF(2),LOCSAC(79),LOCVPC(18),LOCSDF(4),LOCLG(7)
C
C     SETTING UP TABLES FOR TFFS
C
      CALL TSRCH(6HTTAB1.,LOCTFF,2,IER)
      RETURN
C
C     SETTING UP TABLES FOR SACS
C
      ENTRY SACS2
      CALL TSRCH(6HATAB01,LOCSAC(1),79,IER)
      RETURN
C
C     SETTING UP TABLES FOR VPCS2
C
      ENTRY VPCTAB
      CALL TSRCH(6HVTAB01,LOCVPC(1),18,IER)
      RETURN
C
C     SETTING UP TABLES FOR OPT2
C
      ENTRY OPTTAB
      CALL TSRCH(6HDTAB01,LOCSDF(1),4,IER)
      RETURN
C
C     SETTING UP TABLES FOR LGEAR
C
      ENTRY LGTAB
      CALL TSRCH(6HFTAB01,LOCLG(1),3,IER)
      CALL TSRCH(6HCTAB01,LOCLG(4),4,IER)
      RETURN
      END
      SUBROUTINE READ
      COMMON /READ1/ FI(56) , ITABLE , IID , IDD,
     *IBC,K,IBCRW,INX,SLTSYM,JBC,INXQ
      DIMENSION MSG(58),RA(55),RA1(6)
      EQUIVALENCE (MSG( 1),SYM) , (MSG( 2),OP )
      EQUIVALENCE (MSG( 3),RA ) , (MSG(58),INC)
      REAL F.(2,28),MRG,NOXEQ
      LOGICAL STSWCH , TABSTP
      COMMON  /STOPIT/ STSWCH , TABSTP
      DATA BCD,AINT,STCASE,TRA,MRG,NOXEQ,OCT,COMMA/
     *     3HBCD,3HINT,6HSTCASE,3HTRA,3HMRG,1HN,3HOCT,1H,/
      DATA BLANK,POINT,EE/1H ,1H.,1HE/
      DATA TABLED / 3HTAB /
 1    FORMAT (11E12.3)
 2    FORMAT (5X,I6,10E12.0)
 3    FORMAT (11012)
 4    FORMAT(A6,1X,A3,1X,55A1,6A1)
 5    FORMAT (23H0ERROR.THE SYMBOL **A6,26H** IS NOT IN THE DIRECTORY/
     *       1H )
 6    FORMAT (22A6)
 7    FORMAT (  I6)
 8    FORMAT (46H ERROR.AN STCASE MRG CARD HAS BEEN ENCOUNTERED,
     *        42H FOR WHICH NO BASE CASE IS AVAILABLE.ERROR       )
 9    FORMAT (52H ERROR.INPUT DECK NOT STARTED WITH STCASE CARD.ERROR)
 10   FORMAT (18X,A6,1X,A3,1X,55A1,I6)
 11   FORMAT (25H0ERROR.COLUMN 12 IS BLANK/1H0)
 12   FORMAT (27H0NO-EXECUTE OPTION SELECTED)
 13   FORMAT (11I12)
      FORMAT (55A1)
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```
  5    FORMAT (I1 , 9A6)
       K = 0
       DO 16 I=1,2
       DO 16 J=1,28
 16    FU(I,J)=0.
 100   READ(5,4)SYM,OP,RA,RA1
       IF(EOF,5) 18,19
 18    REWIND 13
       STOP 22
 19    CALL DIPLAC(RA1,INC,BLANK)
C
 20    IF (SYM .NE. STCASE) GO TO 150
 21    STSWCH = .FALSE.
       CALL DEF
 101   IF (OP  .NE. MRG   ) GO TO 115
       IF (JBC .LT.0) GO TO 700
       IF (IBC .EQ.0) GO TO 110
C TERMINATE BASE CASE AUXILIARY FILE
       IID = -10
       WRITE (16) IID,IID,FI,SYM,OP,RA,INC,ITABLE
       ENDFILE 16
 110   IBC = 0
       REWIND 16
       IBCRW= 0
       K = 1
       GO TO 120
 115   IBC = 1
       INXQ= 1
       JBC = 1
       K   = 1
       IF (OP .NE. TABLED) GO TO 120
       CALL TABRE
       IF (TABSTP) GO TO 306
 120   INX = 1
       IF ( RA(1) .NE. NOXEQ) GO TO 124
       INX = 0
       CALL LINES (2)
       WRITE (6,12)
 124   IF ( IBC .EQ. 0) GO TO 130
       REWIND 16
       IBCRW = 0
       GO TO 130
 130   IF (INX .EQ. 0) GO TO 801
       IF (IBC .EQ. 0)CALL READA  (IBCRW)
       GO TO 100
 150   IF (JBC .NE. 1) GO TO 705
       IF (STSWCH)        GO TO 306
       IF (K    .EQ. 0) GO TO 170
 152   IF (OP  .NE. TRA) GO TO 200
       CALL LINES (1)
       WRITE (6,10) SYM,OP
       IF (IBC .EQ. 0) GO TO 160
       IID = -1
       WRITE (16) IID,IID,FI,SYM,OP,RA,INC,ITABLE
 160   IF (INX .EQ. 0) GO TO 100
       IF (INXQ.NE. 1) GO TO 100
       SLTSYM = SYM
       RETURN
 170   IF (IBC .NE.0) GO TO 152
 175   CALL READA (IBCRW)
       K = 1
       GO TO 152
 200   IF (K  .NE. 0) GO TO 300
       IF (INX.EQ. 0) GO TO 295
 210   IF (IBC.EQ. 0) CALL READA  (IBCRW)
```

```
 5     K = 1
300    CALL WRCARD (MSG)
301    IF (RA(1) .NE. BLANK) GO TO 302
24     CALL LINES (2)
       WRITE (6,11)
       GO TO 801
 302   IF (SYM .EQ. SLTSYM) GO TO 310
       CALL OSERCH (SYM,IDD,ITABLE)
       IF (ITABLE .LT. 1) GO TO 310
       CALL LINES (3)
       WRITE (6,5) SYM
 306   IF (IBC.NE. 1) GO TO 307
       INXQ = 0
       JBC  =-1
 307   INX  = 0
       GO TO 801
C
C DECODE CARD SECTION
C
 310   IF (OP .NE. BCD) GO TO 400
C
C DATA IS BCD
C
       DECODE(1,1001,RA)N
 1001  FORMAT(I1)
       K1=2
       KK=7
       DO 1088 I=1,N
       ENCODE(10,888,FI(I))(RA(L),L=K1,KK)
       K1=K1+6
       KK=KK+6
 1088  CONTINUE
 888   FORMAT(5A1)
       CALL STORE(N,INC,INX,L)
       IF (IBC .EQ. 0) GO TO 350
       WRITE (16) IID,N,FI,SYM,OP,RA,INC   ,ITABLE
 350   SLTSYM = SYM
       GO TO 100
C
C NUMERIC TYPE DATA
C
 400   IFI = 0
C OCTAL TYPE
       IF (OP .EQ. OCT) IFI=1
C INTEGER TYPE
       IF (OP .EQ.AINT) IFI=4
 405   IQ=0
       LQ=0
       JJ=1
 410   KQ = LQ + 1
 415   LQ = LQ+1
       IF (LQ .GT. 55) GO TO 418
       IF (RA(LQ) .EQ. COMMA) GO TO 420
       IF (RA(LQ) .NE. BLANK) GO TO 415
 418   IQ=1
 420   MQ=LQ-1
       IF (IFI .NE. 0) GO TO 500
 425   JQ=KQ-1
 430   JQ=JQ+1
       IF (RA(JQ) .EQ. POINT) GO TO 435
       IF (RA(JQ) .NE. EE    ) GO TO 440
 435   IFI = 2
       GO TO 500
 440   IF ( JQ .LT. MQ) GO TO 430
       IFI = 3
```

```
 0    CALL PACKRR(RA(KQ),EQ(1,JJ),NQ-KQ+1)
      IF(IQ.NE.0)GO TO 525
520   JJ=JJ+1
      GO TO 410
525   CALL RITE(IFI,FQ,FI,JJ)
600   CALL STORE(JJ,INC,INX,0)
      IF (IBC .NE. 0) WRITE (16) IID,JJ,FI,SYM,OP,RA,INC,ITABLE
      GO TO 350
700   CALL LINES (1)
      WRITE (6,8)
      GO TO 801
705   CALL LINES (1)
      CALL DEF
      WRITE (6,3)
801   SLTSYM = SYM
802   READ (5,4) SYM,OP,RA,INC
      IF(EOF,5) 25,26
25    REWIND 13
      STOP 25
26    IF(SYM.EQ.STCASE)GO TO 21
      CALL WRCARD (MSG)
      IF (OP     .EQ. TRA    ) GO TO 802
      IF (RA(1) .EQ. BLANK ) GO TO 24
      IF (SYM    .EQ. SLTSYM) GO TO 802
      CALL DSERCH (SYM,IDD,ITABLE)
      IF (ITABLE .LT. 1) GO TO 801
      CALL LINES (1)
      WRITE (6,5) SYM
      GO TO 801
      END
       SUBROUTINE DIPLAC(RA1,INC,BLANK)
       DIMENSION RA1(6)
       DIMENSION RC(2)
C      ************************************************************
CPICK UP COLUMN 67 TO 72 AND
CRIGHT JUSTIFY FOR USE IN THE INPUT ROUTINE
C
C
C
C      ************************************************************
       DO 7 I=1,6
       IF (RA1(6) .NE. BLANK) GO TO 2
       DO 1 N=1,6
       N1=7-N
       N2=6-N
 1     RA1(N1)=RA1(N2)
 7     RA1(1)=BLANK
       INC=0
C
C
C     IF EXIT THROUGH GO STATEMENT 2
C     THEN A VALID NUMBER EXIST.
C
       GO TO 6
 2    CALL PACKRR(RA1,RC,6)
      CALL RITE(5,RC,INC,1)
 6     RETURN
      END
      SUBROUTINE TABRE
      COMMON/TABDIR/TABLE(1)
      COMMON  /STOPIT/ STSWCH  , TABSTP
      COMMON/TABCOM/LOCS(115),STABLE(115)
      DIMENSION IS(115),RA1(6)
      LOGICAL STSWCH , TABSTP
      DATA BLANK , BCDTRA / 1H ,3HTRA /
```

```
      DATA MAXT  , MAXTAB / 115,800/
      TABSTP = .FALSE.
      DO 5 I=1,MAXT
5     IS(I) = 0
      SYMTRA = BLANK
      NSUM= 0
      NTR=0
      WRITE (6,3)
3     FORMAT (35X,43HTABLE SIZES FOR EACH TABLE USED IN THIS RUN)
10    READ(5,11)SYM,SYMTRA,RA1
11    FORMAT(A6,1X,A3,1X,6A1)
      CALL DIPLAC(RA1,NTSIZE,BLANK)
      CALL LINES (1)
      IF (SYMTRA .EQ. BCDTRA) GO TO 21
      WRITE (6,4) SYM,SYMTRA,NTSIZE
4     FORMAT (18X,A6,1X,A3,1X,I4)
      DO 15 J=1,MAXT
      IF (SYM .NE. STABLE(J) ) GO TO 15
      IS(J)=NTSIZE
      NSUM = NSUM+NTSIZE
      NTR=NTR+1
      GO TO 10
15    CONTINUE
      TABSTP = .TRUE.
      CALL LINES (2)
      WRITE (6,24) SYM
24    FORMAT (1H0,36X,A6,29H DOES NOT EXIST IN TABLE LIST)
      GO TO 10
21    CALL LINES (2)
      WRITE (6,4 ) BLANK,SYMTRA
      NSUM=NSUM+MAXT-NTR
      WRITE (6,22) NSUM
22    FORMAT(35X,     39HTOTAL NUMBER OF CELLS FOR ALL TABLES =  I4)
      IF (NSUM .LE. MAXTAB) GO TO 200
      TABSTP = .TRUE.
      CALL LINES(2)
      WRITE(6,23) MAXTAB , NSUM
23    FORMAT(1H0,10X,25HTOTAL TABLE SIZES EXCEED I4,4H .  ,
     *36HCHANGE MAXIMUM TOTAL TABLE SIZES TO ,I4/
     *25H IN THE MAIN PROGRAM TOLA)
200   KONT=1
      DO 250 I=1,MAXT
      LOCS(I)=KONT
250   KONT = KONT+IS(I)
      RETURN
      END
      SUBROUTINE READA (IBCRW)
      COMMON/READ1/FI(56),ITABLE,IID,IDD,DM(7)
      INTEGER MSG(58)
      IF (IBCRW .NE. 0) RETURN
100   READ (16) IID,J ,FI,MSG , ITABLE
      IF (IID .GE. -1) GO TO 105
      IBCRW = 1
      RETURN
105   CALL WRCARD (MSG)
      IF (IID .LT. 0) RETURN
      CALL STORE(J,IDUM1,IDUM2,1)
      GO TO 100
      END
      SUBROUTINE STORE(N,INC,INX,STAPE)
      INTEGER STAPE
      COMMON/READ1/FI(56),ITABLE,IID,IDD,DM(7)
      COMMON/DIRCOM/DATA(3959)
      COMMON/TABDIR/TABLE(1)
      IF(STAPE.NE.0)GO TO 50
```

```
      MIORQ = 0
      IF (INC.GT.0) MIORQ = -1
      IID = IDD+INC+MIORQ
      IF (INX .EQ. 0) RETURN
 50   J=IID
      IF (ITABLE .LT. 0) GO TO 2
      DO 1 I=1,N
      DATA (J) = FI(I)
 1    J = J+1
      RETURN
 2    DO 3 I=1,N
      TABLE(J) = FI(I)
 3    J = J+1
      RETURN
      END
      SUBROUTINE HRCARD(MSG)
      INTEGER MSG(58)
C
      CALL LINES (1)
      J = 58
      IF (MSG(58) .LE. 0) J =57
      WRITE (6,10) (MSG(I),I=1,J)
 10   FORMAT (18X,A6,1X,A3,1X,55A1,I6)
      RETURN
      END
      SUBROUTINE PACK (I1,I2,N)
      DIMENSION I1(1)
      DATA  IBL / 6H      /
    1 FORMAT (6A1)
    2 FORMAT ( A6)
      REWIND 31
      IF (N.GE.6) GO TO 3
      K = 6 - N
      WRITE (31,1) (IBL, I = 1,K),(I1(I), I = 1,N)
      GO TO 4
    3 WRITE (31,1) (I1(I), I = 1,6)
 4    REWIND 31
      READ (31,2) I2
      RETURN
      END
      SUBROUTINE DSERCH (SYM,IOC,IER)
      COMMON/FIXDIP/ANAME(900),LOC(900),NCOUNT
      DO 50 I=1,NCOUNT
      IF (SYM .NE. ANAME(I) ) GO TO 50
      IER = 0
      IOC = LOC(I)
      RETURN
 50   CONTINUE
      CALL TSRCH (SYM,IOC,1,IER)
      RETURN
C
      END
      SUBROUTINE PACKRR(I1,I2,NNN)
      DIMENSION I1(1)
 1000 FORMAT(1H(,I2,2HX,I2,3HA1))
      K=20-NNN
      ENCODE(10,1000,XMAT)K,NNN
      ENCODE(20,XMAT,I2)(I1(I),I=1,NNN)
      RETURN
      END
      SUBROUTINE RITE(IFI,FJ,FI,JJ)
      DIMENSION FI(56),FJ(56)
      GO TO (100,200,300,400),IFI
 100  II=1
      DO 101 I=1,JJ
```

```
      DECODE(20,1,FJ(II))FI(I)
      II=II+2
101   CONTINUE
1     FORMAT(O20)
      RETURN
200   II=1
      DO 201 I=1,JJ
      DECODE(20,2,FJ(II))FI(I)
      II=II+2
201   CONTINUE
2     FORMAT(E20.0)
      RETURN
300   II=1
      J1=JJ
      JJ=1
      DECODE(20,5,FJ)(FI(I),I=1,JJ)
      JJ=J1
      IF(JJ.EQ.1)RETURN
      II=II+2
      DO 301 I=2,JJ
      DECODE(20,2,FJ(II))FI(I)
      II=II+2
301   CONTINUE
5     FORMAT(10X,I10/(E20.0))
3     FORMAT(I20,(E20.0))
      RETURN
400   II=1
      DO 401 I=1,JJ
      DECODE(20,4,FJ(II))FI(I)
      II=II+2
401   CONTINUE
4     FORMAT(I20)
      RETURN
      END
      BLOCK DATA DIRDA
      COMMON/FIXDIR/NAME(900),LOC(900),NCOUNT
C               GENERAL DIRECTORY ROUTINE
      DATA   (NAME(I),I=1,126)/
     *   6HAA77P ,6HAELER1,6HAE77F ,6HAINCPS,6HAIXR7S,6HAIXXUS,6HAIXXS1,
     *   6HAIXYUS,6HAIXYS1,6HAIXZBS,6HAIXZS1,6HAIYYBS,6HAIYYS1,6HAIYZBS,
     *   6HAIYZS1,6HAIZZBS,6HAIZZS1,6HAJG   ,6HAKA   ,6HAKB   ,6HAKD   ,
     *   6HAKF   ,6HAKGPAV,6HAKZ   ,6HAK1   ,6HTR    ,6HTIMER ,6HAK13  ,
     *   6HAK14  ,6HAK15  ,6HAK16  ,6HAK17  ,6HAK18  ,6HAK19  ,6HAK2   ,
     *   6HAK20  ,6HAK21  ,6HAK22  ,6HAK23  ,6HAK24  ,6HAK25  ,6HAK26  ,
     *   6HAK3   ,6HAK6   ,6HAK7   ,6HALAMF1,6HALAMF2,6HALAMIF,6HALAMTD,
     *   6HALA77F,6HALB77F,6HALP77F,6HALIFTP,6HALIMG ,6HALIML ,6HALLJDF,
     *   6HALMJDF,6HALNJDF,6HALPHD ,6HALPHR1,6HALPND ,6HALPTC ,6HALT77F,
     *   6HALYJDF,6HALZJDF,6HAL01  ,6HAL02  ,6HAL03  ,6HAL04  ,6HAMACH ,
     *   6HAMASES,6HAMASE1,6HAMASS ,6HAMASS1,6HAMASZS,6HAMAXER,6HAMAXH ,
     *   6HAMA77F,6HAMU77F,6HAMINER,6HAMT77F,6HAMU   ,6HAMU77H,6HAN    ,
     *   6HANAB7G,6HANAZ7F,6HANA77P,6HANB77F,6HANGAMG,6HANPSIG,6HANSIGG,
     *   6HANTHTG,6HANT77F,6HANUA7F,6HANVH7G,6HAREFF ,6HAXP7F ,6HAX77F ,
     *   6HAYP7F ,6HAY77F ,6HAZP7F ,6HA777D ,6HAZ77F ,6HA777D ,6HBA77D ,
     *   6HBELER2,6HBETAD ,6HBETAR1,6HBI77D ,6HBLIMG ,6HBLIML ,6HBP77D ,
     *   6HB01   ,6HB02   ,6HB12   ,6HB13   ,6HB141  ,6HB142  ,6HB143  ,
     *   6HB144  ,6HB16   ,6HB17   ,6HB18   ,6HB19   ,6HB20   ,6HB21   /
      DATA   (NAME(J),J=127,252)/
     *   6HB22   ,6HCA    ,6HCALPG ,6HCAMNU ,6HCBETG ,6HCD    ,6HCDMNU  ,
     *   6HCDYNP ,6HCGAMG ,6HCGAM71,6HCL    ,6HCLMNU ,6HCM    ,6HCMMNU  ,
     *   6HCN2MNU,6HCNIMNU,6HCP    ,6HCRM   ,6HCY    ,6HCYA   ,6HCYH    ,
     *   6HCYMNU ,6HDECKLS,6HDELND ,6HDELPD ,6HDELQD ,6HDELRD ,6HDELTS  ,
     *   6HDELT1 ,6HDELT2 ,6HDELT3 ,6HDLFXP ,6HDLFYP ,6HDLFZP ,6HDLH1   ,
     *   6HDLLTF ,6HDLMTF ,6HDLNTF ,6HDLTM1 ,6HDLTM2 ,6HDLTM3 ,6HDLTSF  ,
     *   6HDRAGP ,6HDTC2R ,6HDXCGF ,6HDYNPP ,6HDYNPP1,6HD1    ,6HD1RFF  ,
     *   6HD2    ,6HD2RFF ,6HD3    ,6HD4    ,6HD5    ,6HD6    ,6HD777D  ,
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*     6HEPS1   ,6HEPS10  ,6HEPS11  ,6HEPS12  ,6HEPS13  ,6HEPS14  ,6HEPS15  ,
*     6HEPS16  ,6HEPS17  ,6HEPS18  ,6HEPS19  ,6HEPS2   ,6HEPS20  ,6HEPS21  ,
*     6HEPS22  ,6HEPS23  ,6HEPS24  ,6HEPS25  ,6HEPS26  ,6HEPS3   ,6HEPS4   ,
*     6HEPS5   ,6HEPS6   ,6HEPS7   ,6HEPS8   ,6HEPS9   ,6HFXB7P  ,6HFXE7P  ,
*     6HFYB7P  ,6HFYE7P  ,6HFZB7P  ,6HFZE7P  ,6HGAMOD  ,6HGAMIF  ,6HGAMIF1 ,
*     6HGAMIF2 ,6HGAM7D  ,6HGREFF  ,6HGXB7F  ,6HGXE7F  ,6HGXG7F  ,6HGXI7F  ,
*     6HGYB7F  ,6HGYE7F  ,6HGYI7F  ,6HGZB7F  ,6HGZE7F  ,6HGZG7F  ,6HGZI7F  ,
*     6HHA77D  ,6HHG     ,6HHGC7F  ,6HHH     ,6HHRFAB  ,6HPRINT  ,6HIA80X  ,
*     6HIA80Y  ,6HIA81X  ,6HIA81Y  ,6HIA82X  ,6HIA82Y  ,6HIA83X  ,6HIA83Y  ,
*     6HIA84X  ,6HIA84Y  ,6HIA85X  ,6HIA85Y  ,6HIA86X  ,6HIA86Y  ,6HIA87X  /
 DATA   (LOC(I),I=1,126)/
*      20    ,   11    ,   24    ,   25    ,   29    ,   30    ,   31    ,
*      32    ,   33    ,   34    ,   35    ,   37    ,   38    ,   39    ,
*      40    ,   42    ,   43    ,   44    ,   45    ,   46    ,   47    ,
*      48    ,   49    ,   72    ,   73    ,   74    ,   75    ,   76    ,
*      77    ,   78    ,   79    ,   80    ,   81    ,   82    ,   83    ,
*      84    ,   85    ,   86    ,   87    ,   88    ,   89    ,   90    ,
*      91    ,   94    ,   95    ,   99    ,  102    ,  101    ,  103    ,
*     105    ,  106    ,  108    ,  109    ,  110    ,  111    ,  112    ,
*     113    ,  116    ,  117    ,  121    ,  123    ,  125    ,  127    ,
*     128    ,  129    ,  130    ,  131    ,  132    ,  133    ,  134    ,
*    1138    , 1140    ,  137    ,  138    ,  139    ,   10    ,  140    ,
*     141    ,  142    ,    9    ,  145    ,  146    ,  147    ,  149    ,
*     150    ,  151    ,  152    ,  153    ,  155    ,  156    ,  157    ,
*     158    ,  159    ,  160    ,  162    ,  163    ,  164    ,  165    ,
*     166    ,  167    ,  168    ,  169    ,  170    ,  171    ,  173    ,
*      17    ,  175    ,  179    ,  181    ,  183    ,  184    ,  185    ,
*     187    ,  188    ,  189    ,  190    ,  191    ,  192    ,  193    ,
*     194    ,  195    ,  196    ,  197    ,  198    ,  199    ,  200    /
 DATA   (LOC(J),J=127,252)/
*     201    ,  202    ,  852    ,  205    ,  863    ,  212    ,  215    ,
*     216    ,  859    ,  860    ,  222    ,  226    ,  227    ,  228    ,
*     229    ,  230    ,  231    ,  242    ,  250    ,  250    ,  252    ,
*     253    ,  321    ,  325    ,  327    ,  329    ,  331    ,  333    ,
*     334    ,  335    ,  336    ,  337    ,  338    ,  339    ,  340    ,
*     341    ,  343    ,  344    ,  345    ,  346    ,  347    ,  348    ,
*     349    ,  350    ,  351    ,  355    ,  353    ,  356    ,  357    ,
*     358    ,  359    ,  360    ,  361    ,  362    ,  363    ,  144    ,
*     366    ,  367    ,  368    ,  369    ,  370    ,  371    ,  372    ,
*     373    ,  374    ,  375    ,  376    ,  377    ,  378    ,  379    ,
*     380    ,  381    ,  382    ,  383    ,  384    ,  385    ,  386    ,
*     387    ,  388    ,  389    ,  390    ,  391    ,  393    ,  395    ,
*     397    ,  399    ,  401    ,  403    ,  406    ,  410    ,  411    ,
*     412    ,  414    ,  417    ,  419    ,  420    ,  421    ,  422    ,
*     424    ,  425    ,  426    ,  428    ,  429    ,  430    ,  431    ,
*     432    ,  434    ,  435    ,  439    ,  440    , 1023    ,  442    ,
*     443    ,  444    ,  445    ,  446    ,  447    ,  448    ,  449    ,
*     450    ,  451    ,  452    ,  453    ,  454    ,  455    ,  456    /
 END
 BLOCK DATA DIR10A
 COMMON/FIXDIR/NAME(900),LOC(900),NCOUNT
 DATA   (NAME(K),K=253,378)/
*     6HIA87Y  ,6HIA90X  ,6HIA90Y  ,6HIA90Z  ,6HIA91X  ,6HIA91Y  ,6HIA91Z  ,
*     6HIA92X  ,6HIA92Y  ,6HIA92Z  ,6HIA93X  ,6HIA93Y  ,6HIA93Z  ,6HIA94X  ,
*     6HIA94Y  ,6HIA94Z  ,6HIA95X  ,6HIA95Y  ,6HIA95Z  ,6HIDISPL,6HIECONT,
*     6HIMTHJ  ,6HINDACC,6HINDACM,6HINDAUD,6HINDADT,6HINDAED,6HINDAEP,
*     6HINDAER,6HINDAIM,6HINDAPC,6HINDATH,6HINDATM,6HINDAUT,6HINDA01,
*     6HINDA02,6HINDA03,6HINDA04,6HINDA05,6HINDA06,6HINDA07,6HINDA08,
*     6HINDA09,6HINDA10,6HINDA11,6HINDA12,6HINDA13,6HINDA14,6HINDA15,
*     6HINDA16,6HINDA17,6HINDA18,6HINDA19,6HINDA20,6HINDA21,6HINDA22,
*     6HINDA23,6HINDA24,6HINDA25,6HINDA26,6HINDA27,6HINDA28,6HINDA29,
*     6HINDA30,6HINDA31,6HINDA32,6HINDA33,6HINDA34,6HINDA35,6HINDA36,
*     6HINDA37,6HINDA38,6HINDA39,6HINDA40,6HINDA41,6HINDA42,6HINDA43,
*     6HINDA44,6HINDA45,6HINDA46,6HINDA47,6HINDA48,6HINDA49,6HINDA50,
*     6HINDA51,6HINDA52,6HINDA53,6HINDA54,6HINDA55,6HINDA56,6HINDA57,
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     *     6HINDA58,6HINDA59,6HINDA60,6HINDA61,6HINDA62,6HINDA63,6HINDA64,
     *     6HINDA65,6HINDA66,6HINDA67,6HINDA68,6HINDA69,6HINDA70,6HINDA71,
     *     6HINDA72,6HINDA73,6HINDA74,6HINDA75,6HINDA76,6HINDA77,6HINDA78,
     *     6HINDA80,6HINDA81,6HINDA82,6HINDA83,6HINDA84,6HINDA85,6HINDA86,
     *     6HINDA87,6HINDA90,6HINDA91,6HINDA92,6HINDA93,6HINDA94,6HINDA95/
      DATA   (NAME(L),L=379,504)/
     *     6HINDBAD,6HINDCCT,6HINDCGT,6HINDCNV,6HINDDCR,6HDTMIN  ,6HINDDYR,
     *     6HINDEDT,6HINDFLT,6HINDFPA,6HINDFPD,6HINDFPR,6HINDGCR,6HINDGFP,
     *     6HINDGRT,6HINDGSR,6HINDGVT,6HINDHET,6HINDHTL,6HINDIDT,6HINDINP,
     *     6HINDINV,6HINDJUP,6HINDLAT,6HINDLUF,6HINDLEA,6HINDMAC,6HINDPLA,
     *     6HINDPOR,6HINDPSC,6HINDRHO,6HINDRTT,6HINDR01,6HINDR02,6HINDR03,
     *     6HINDR04,6HINDR05,6HINDR06,6HINDR07,6HINDR08,6HINDR09,6HINDR10,
     *     6HINDR11,6HINDR12,6HINDR13,6HINDR14,6HINDR15,6HINDR16,6HINDR17,
     *     6HINDR18,6HINDR19,6HINDR2Y,6HINDR20,6HINDR21,6HINDR22,6HINDR23,
     *     6HINDR24,6HINDR25,6HINDR26,6HINDR27,6HINDR28,6HINDSCL,6HINDSPL,
     *     6HINDSQT,6HINDSTF,6HINDSTR,6HINDSTY,6HINDSWT,6HINDTFF,6HINDTSO,
     *     6HINDVPC,6HINDWGT,6HINDWIN,6HINDXYS,6HINDXZS,6HSIGTOL,6HIPCONT,
     *     6HIP1   ,6HIP2   ,6HIQ    ,6HITCASE,6HIT10W ,6HIT10X ,6HIT10Y ,
     *     6HIT10Z ,6HIT11W ,6HIT11X ,6HIT11Y ,6HIT11Z ,6HIVARBH,6HNCASE ,
     *     6HNSTAGE,6HOG01  ,6HOMGPR ,6HOMGRT ,6HOMXGR ,6HOMZGR ,6HPA77P ,
     *     6HPE77R ,6HPHGZD ,6HPHIAD ,6HPHIBD ,6HPHIGD ,6HPHILD ,6HPHIRD ,
     *     6HPHITD ,6HPHLZD ,6HPI77R ,6HPI77R1,6HPM77R ,6HPRNC  ,6HPSIDD ,
     *     6HPSIPD ,6HPST7D ,6HQA77D ,6HQE77R ,6HQI77R ,6HQI77R1,6HQM77R ,
     *     6HRA77D ,6HRD77N ,6HREM   ,6HRE77F ,6HRE77R ,6HRG77N ,6HRHN7F /
      DATA   (LOC(K),K=253,378)/
     *       457   ,  458   ,  459   ,  460   ,  461   ,  462   ,  463   ,
     *       464   ,  465   ,  466   ,  467   ,  468   ,  469   ,  470   ,
     *       471   ,  472   ,  473   ,  474   ,  475   ,  365   ,  364   ,
     *         1   , 1042   ,  477   ,  478   , 1038   ,  930   ,  479   ,
     *       480   ,  481   ,  482   ,  484   ,  485   ,  486   ,  487   ,
     *       488   ,  489   ,  490   ,  491   ,  492   ,  493   ,  494   ,
     *       495   ,  496   ,  497   ,  498   ,  499   ,  500   ,  501   ,
     *       502   ,  503   ,  504   ,  505   ,  506   ,  507   ,  508   ,
     *       509   ,  510   ,  511   ,  512   ,  513   ,  514   ,  515   ,
     *       516   ,  517   ,  518   ,  519   ,  520   ,  521   ,  522   ,
     *       523   ,  524   ,  525   ,  526   ,  527   ,  528   ,  529   ,
     *       530   ,  531   ,  532   ,  533   ,  534   ,  535   ,  536   ,
     *       537   ,  538   ,  539   ,  540   ,  541   ,  542   ,  543   ,
     *       544   ,  545   ,  546   ,  547   ,  548   ,  549   ,  550   ,
     *       551   ,  552   ,  553   ,  554   ,  555   ,  556   ,  557   ,
     *       558   ,  559   ,  560   ,  561   ,  562   ,  563   ,  564   ,
     *       565   ,  566   ,  567   ,  568   ,  569   ,  570   ,  571   ,
     *       572   ,  573   ,  574   ,  575   ,  576   ,  577   ,  578   /
      DATA   (LOC(L),L=379,504)/
     *       579   , 1036   , 1037   , 1040   ,  580   ,  581   ,  582   ,
     *       583   ,  587   ,  588   ,  589   ,  590   ,  591   ,  592   ,
     *       593   ,  594   ,  595   ,  596   ,  597   ,  598   ,  600   ,
     *       601   ,  602   ,  603   ,  604   ,  605   , 1041   ,  607   ,
     *       608   ,  609   ,  612   , 1134   ,  615   ,  616   ,  617   ,
     *       618   ,  619   ,  620   ,  621   ,  622   ,  623   ,  624   ,
     *       625   ,  626   ,  627   ,  628   ,  629   ,  630   ,  631   ,
     *       632   ,  633   , 1039   ,  634   ,  635   ,  636   ,  637   ,
     *       638   ,  639   ,  640   ,  641   ,  642   ,  643   ,  646   ,
     *      1035   ,  648   ,  652   ,  653   ,  654   ,  655   ,  656   ,
     *       657   ,  658   ,  659   ,  660   ,  661   ,    4   ,  662   ,
     *         6   ,    7   ,    8   ,  663   ,  911   ,  912   ,  913   ,
     *       914   ,  915   ,  916   ,  917   ,  918   ,    5   ,  665   ,
     *       667   ,  669   ,  671   ,  673   ,  675   ,  676   ,  678   ,
     *       679   ,  680   ,  682   ,  684   ,  685   ,  689   ,  695   ,
     *       699   ,  703   , 1170   , 1172   ,  710   ,  713   ,  714   ,
     *       719   ,  723   ,  724   ,  726   , 1178   , 1180   ,  729   ,
     *       732   , 1182   ,  735   ,  765   ,  766   ,  771   ,  773   /
      END
      BLOCK DATA DIR20A
      COMMON/FIXDIR/NAME(900),LOC(900),NCOUNT
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      DATA NCOUNT/894/
      DATA    (NAME(M),M=505,637)/
     *    6HRHOAS  ,6HRHOSP  ,6HRI77R  ,6HRI77R1,6HRM77R  ,6HRNCR   ,6HRNGMN  ,
     *    6HRNKHG  ,6HRNKHL  ,6HRNFHG  ,6HRNRHL  ,6HRNTP   ,6HRNTR   ,6HRNTY   ,
     *    6HRNYHG  ,6HRNYHL  ,6HRPHLF  ,6HRPLZF  ,6HRP77F  ,6HR777F  ,6HSGDCB  ,
     *    6HSIDEP  ,6HSIGDD  ,6HSIGN   ,6HSIGZD  ,6HSIG7D  ,6HSIG7R1,6HSTEST  ,
     *    6HSTESTD,6HTA01   ,6HTA02   ,6HTA03   ,6HTA04   ,6HTA05   ,6HTA06   ,
     *    6HTA07   ,6HTA10   ,6HTA11   ,6HTA14   ,6HTA77R  ,6HTE77P  ,6HTHLZD  ,
     *    6HTHL7D  ,6HTHTDD  ,6HTHTPJ  ,6HTHTRD  ,6HTHTTD  ,6HTIME   ,6HTIMES  ,
     *    6HTIME1  ,6HTIME3  ,6HTIME4  ,6HTIMSX  ,6HTIUPH  ,6HTMAX   ,6HTR77R  ,
     *    6HTSTGR  ,6HTSTGR1,6HTS77R  ,6HTS77R1,6HTVACP  ,6HTXA7P  ,6HTXB7P  ,
     *    6HTXE7P  ,6HTYA7P  ,6HTYB7P  ,6HTYE7P  ,6HTZA7P  ,6HTZB7P  ,6HTZE7P  ,
     *    6HT1     ,6HUM77F  ,6HUPSIF  ,6HUPSIF1,6HUPSIF2,6HU777F  ,6HU777F1,
     *    6HVA77F  ,6HVD77F  ,6HVGRUF  ,6HVG77F  ,6HVI77F  ,6HVM77F  ,6HVP77F  ,
     *    6HVS77F  ,6HVTHEF  ,6HV777F  ,6HV777F1,6HWM77F  ,6HWTR7P  ,6HW777F  ,
     *    6HW777F1,6HXCGBF  ,6HXCGRF  ,6HXD77D  ,6HXD77N  ,6HXE77F  ,6HXGW7F1,
     *    6HXGZ7F  ,6HXG77F  ,6HXI77F  ,6HXN77F  ,6HYA77P  ,6HYCGBF  ,6HYD77D  ,
     *    6HYD77N  ,6HYE77F  ,6HYGW7F1,6HYGZ7F  ,6HYG77F  ,6HYI77F  ,6HYN77F  ,
     *    6HZCGBF  ,6HZE77F  ,6HZGW7F1,6HZGZ7F  ,6HZG77F  ,6HZI77F  ,6HZN77F  ,
     *    6HZTJ1   ,6HNDEBUG,6HCDEBUG,6HMPASS  ,6HNSMAIN,6HNS2NDY,6HINTDMP,
     *    6HOBTYPE,6HNSTRUT,6HMASS   ,6HRX     ,6HRY     ,6HRZ     ,6HTHETAD/
      DATA    (LOC(M),M=505,637)/
     *     774     , 775     ,1186    ,1188    , 779     , 782     ,1088    ,
     *     783     , 784     , 785     , 785     , 787     , 788     , 789     ,
     *     790     , 791     , 792     , 793     , 794     , 795     , 808     ,
     *     809     , 812     , 815     , 586     , 816     , 818     , 835     ,
     *     839     , 850     , 851     , 852     , 853     , 854     , 855     ,
     *     856     , 857     , 858     , 861     , 864     , 865     , 869     ,
     *    1190     , 872     , 876     , 878     , 881     , 882     , 885     ,
     *     886     , 887     , 888     , 889     , 890     , 895     , 897     ,
     *     898     , 899     ,1200    ,1202    , 900     , 901     , 902     ,
     *     903     , 904     , 905     , 906     , 907     , 908     , 909     ,
     *     910     , 922     , 927     , 928     , 929     ,1204    ,1206    ,
     *     933     ,1208    ,1212    , 937     , 938     , 942     ,1216    ,
     *     945     ,1220    ,1224    ,1226    , 952     , 956     ,1228    ,
     *    1230     , 960     , 961     , 962     , 963     ,1232    , 967     ,
     *     969     ,1238    ,1242    , 975     , 981     , 983     , 984     ,
     *     985     ,1246    , 990     , 992     ,1252    ,1256    , 999     ,
     *    1006     ,1260    ,1009    ,1011    ,1266    ,1270    ,1017    ,
     *    1020     ,1272    ,1293    ,1314    ,1315    ,1316    ,1317    ,
     *    1318     ,1322    ,1323    ,1328    ,1333    ,1338    ,1343    /
      DATA    (NAME(N),N=638,769)/
     *    6HERDEG  ,6HRGR    ,6HNTIRES,6HPZERO  ,6HW      ,6HDELTAM,
     *    6HMOMENT,6HRF      ,6HVZ     ,6HIFD    ,6HPZERO  ,6HVZERO  ,6HA      ,
     *    6HP20    ,6HV20    ,6HA2     ,6HIL     ,6HS2T    ,6HES2    ,6HC2L    ,
     *    6HMASS2  ,6HMUS    ,6HCC     ,6HCE     ,6HC2C    ,6HC2E    ,6HNVGPT  ,
     *    6HNPP    ,6HMB     ,6HRLT    ,6HNDELTA,6HES     ,6HSB     ,6HSD21   ,
     *    6HSD22   ,6HSD23   ,6HSD24   ,6HSD25   ,6HSD11   ,6HSD12   ,6HSD13   ,
     *    6HSD14   ,6HSD15   ,6HS1     ,6HSS2    ,6HS3     ,6HS4     ,6HS5     ,
     *    6HS2D21  ,6HS2D22  ,6HS2D23  ,6HS2D24  ,6HS2D25  ,6HS2D11  ,6HS2D12  ,
     *    6HS2D13  ,6HS2D14  ,6HS2D15  ,6HS21    ,6HS22    ,6HS23    ,6HS24    ,
     *    6HS25    ,6HOMTD11,6HOMTD12,6HOMTD13,6HOMTD14,6HOMTD15,6HOMT1  ,
     *    6HOMT2   ,6HOMT3   ,6HOMT4   ,6HOMT5   ,6HAI     ,6HBI     ,6HDELTA1,
     *    6HDELTA2,6HDELTA3,6HDELTA4,6HDELTA5,6HDDELT1,6HDDELT2,6HDDELT3,
     $    6HDDELT4,6HDDELT5,6HISTAGE,6HPRTMIN,6HIPLT   ,6HISDF   ,6HISTPL1,
     *    6HISTPL2,6HISTPL3,6HISTPL4,6HISTPL5,6HIN     ,6HZN     ,6HYN     ,
     *    6HN      ,6HICS    ,6HCDCH   ,6HSSH    ,6HXCH    ,6HYCH    ,6HZCH    ,
     *    6HIB     ,6HITO    ,6HHF     ,6HNF     ,6HXRF    ,6HHRF    ,6HDELTAH,
     *    6HKP     ,6HTI     ,6HNLRI   ,6HVS     ,6HXS     ,6HTS     ,6HVATO   ,
     *    6HALPHTO,6HHS     ,6HALPDES,6HIAP    ,6HVD     ,6HDELVE  ,6HEPSGS  ,
     *    6HALPHDS,6HALPHDL,6HHCG    ,6HDELEPS,6HRFH    ,6HPGS    ,6HDELSIG/
      DATA    (LOC(N2),N2=638,769)/
     *    1348     ,1349    ,1350    ,1355    ,1360    ,1365    ,
     *    1370     ,1375    ,1380    ,1381    ,1382    ,1387    ,1392    ,
     *    1397     ,1402    ,1407    ,1412    ,1413    ,1418    ,1423    ,
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*     1428      ,1433      ,1438      ,1443      ,1448      ,1453      ,1458      ,
*     1459      ,1460      ,1465      ,1466      ,1467      ,1472      ,1477      ,
*     1479      ,1481      ,1483      ,1485      ,1487      ,1489      ,1491      ,
*     1493      ,1495      ,1497      ,1499      ,1501      ,1503      ,1505      ,
*     1507      ,1509      ,1511      ,1513      ,1515      ,1517      ,1519      ,
*     1521      ,1523      ,1525      ,1527      ,1529      ,1531      ,1533      ,
*     1535      ,1537      ,1539      ,1541      ,1543      ,1545      ,1547      ,
*     1549      ,1551      ,1553      ,1555      ,1557      ,1562      ,1567      ,
*     1568      ,1569      ,1570      ,1571      ,1572      ,1573      ,1574      ,
*     1575      ,1576      ,1577      ,1578      ,1579      ,1580      ,1581      ,
*     1582      ,1583      ,1584      ,1585      ,1586      ,1587      ,1592      ,
*     1597      ,1602      ,1603      ,1604      ,1605      ,1606      ,1607      ,
*     1608      ,1613      ,1614      ,1615      ,1616      ,1617      ,1618      ,
*     1619      ,1620      ,1621      ,1622      ,1623      ,1624      ,1625      ,
*     1626      ,1627      ,1628      ,1629      ,1630      ,1631      ,1632      ,
*     1633      ,1634      ,1635      ,1636      ,1637      ,1638      ,1639      /
 DATA   (NAME(N3),N3=770,874)/
*     6HRFY     ,6HPHIC    ,6HTTO     ,6HXTD     ,6HHTD     ,6HVXTD    ,6HVHTD    ,
*     6HIIR     ,6HLD      ,6HDA      ,6HTL      ,6HTU      ,6HKE      ,6HPM      ,
*     6HTSP     ,6HTRV     ,6HTCH     ,6HTBK     ,6HISS     ,6HILP     ,6HIRS     ,
*     6HIC      ,6HXRF1    ,6HIT1     ,6HXRF2    ,6HIT2     ,6HH1      ,6HIH1     ,
*     6HH2      ,6HIH2     ,6HHR1     ,6HIHR1    ,6HHR2     ,6HIHR2    ,6HTR1     ,
*     6HITR1    ,6HTR2     ,6HITR2    ,6HTBK1    ,6HIBK1    ,6HTBK2    ,6HIBK2    ,
*     6HDELON   ,6HRFALPH  ,6HDELALA  ,6HPSH     ,6HTST     ,6HDELQF   ,6HDELFD1  ,
*     6HDELQTU  ,6HDELQL   ,6HDELQU   ,6HINDLG   ,6HRFB     ,6HDELBA   ,6HPSR     ,
*     6HRFPSI   ,6HDPSIA   ,6HPSPSI   ,6HDELRL   ,6HDELRU   ,6HRFPHI   ,6HDPHIA   ,
*     6HPSA     ,6HDELPL   ,6HDELPU   ,6HTF      ,6HNDF     ,6HIR      ,6HNB      ,
*     6HNCR     ,6HNTD     ,6HK2      ,6HK3      ,6HK4      ,6HMBC     ,6HPD      ,
*     6HDELTAH  ,6HCHECD1  ,6HMBL     ,6HMBU     ,6HDELHS   ,6HDELRRD  ,6HDELA    ,
*     6HNED1    ,6HHR      ,6HDELQDE  ,6HMANLOG  ,6HRFALP2  ,6HPSH2    ,6HDELQC   ,
*     6HDELQC2  ,6HALPDL   ,6HAUXICP  ,6HPITCHP  ,6HYAWAUP  ,6HROLLAP  ,6HRAKAP   ,
*     6HCONTRP  ,6HTHROAP  ,6HINDICP  ,6HRHHGR   ,6HHR01    ,6HXR      ,6HXR01    /
 DATA   (LOC(N4),N4=770,874)/
*     1640      ,1641      ,1642      ,1643      ,1644      ,1645      ,1646      ,
*     1647      ,1648      ,1649      ,1650      ,1651      ,1652      ,1657      ,
*     1658      ,1659      ,1660      ,1661      ,1662      ,1663      ,1664      ,
*     1665      ,1670      ,1671      ,1676      ,1677      ,1682      ,1683      ,
*     1688      ,1689      ,1694      ,1695      ,1700      ,1701      ,1706      ,
*     1707      ,1712      ,1713      ,1718      ,1719      ,1724      ,1725      ,
*     1730      ,1731      ,1732      ,1733      ,1734      ,1735      ,1736      ,
*     1737      ,1738      ,1739      ,1740      ,1741      ,1742      ,1743      ,
*     1744      ,1745      ,1746      ,1747      ,1748      ,1749      ,1750      ,
*     1751      ,1752      ,1753      ,1754      ,1759      ,1764      ,1769      ,
*     1774      ,1779      ,1734      ,1785      ,1790      ,1801      ,1806      ,
*     1807      ,1808      ,1813      ,1818      ,1823      ,1824      ,1825      ,
*     1826      ,1827      ,1828      ,1829      ,1830      ,1831      ,1832      ,
*     1833      ,1834      ,1835      ,1136      ,1837      ,1838      ,1839      ,
*     1840      ,1841      ,1842      ,1943      ,1844      ,1845      ,1846      /
 DATA NAME(875)/4HCASK/
 DATA LOC(875)/1848/
 END
 BLOCK DATA DIRDA
 COMMON/FIXDIR/NAME(900),LOC(900 ,NCOUNT
 DATA (NAME(K3),K3=875,894)/
*     6HINOFLX,6HNMODE  ,6HGMASS1,6HGFREQ  ,6HSXMOD  ,6HSYMOD  ,6HSZMOD  ,
*     6HSKC    ,6HTXMOD ,6HOCMODE,6HARMODE,6HNPTS   ,6HOUTMOD,6HRDIS   ,
*     6HPF     ,6HGO     ,6HGQD1 . ,6HGQD2   ,6HIFLX   /
 DATA (LOC(K4),K4=876,894)/
*     1892      ,1893      ,1894      ,1914      ,1934      ,2034      ,2134      ,
*     2234      ,2259      ,2319      ,2379      ,2499      ,2500      ,3700      ,
*     3760      ,3880      ,3900      ,3320      ,3940      /
 END
 OVERLAY(TOLA,2,0)
 PROGRAM TOLANZ
 COMMON/CONTRO/ICONTR,CONTR1,ICONT2,ICONT3
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ORIGINAL PAGE IS
OF POOR QUALITY

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      IF(ICONTR-2)1,2,2
 1    CALL AUTS
      GO TO 19
 2    CALL AUTSPR
19    CONTINUE
      END
      SUBROUTINE AUTS
C
C            A U X I L I A R Y   C O M P U T A T I O N S
C
C          INPUT REQUIRED (FROM DIRCOM)
C     XG77F, YG77F, ZG77F - LOCAL GEOCENTRIC DISPLACEMENTS
C     XG77F1, YG77F1, ZG77F1, AL2, AL27S1, AN2,AN277S,AM2, AM27S1
C     RGR
C
      COMMON/DIRCOM/DM1(73),TRR,DM2J(42),ALPHD,DM2(3),ALPHR1,DM3(15),
     *AMASS,DM4(25),ARCFF,DM5(11),BETAD,DM6(3),BETAR1,DM7(147),
     *DELPD,DM8,DELQD,DM9,DELRD,DM11(61),FX07P,DM12(23),
     *GREFF,DM13(17),HGC7F,DM14(211),INDSTE,DM10(47),PHIPD,
     *DM15(23),PSIPD,DM35(54),RHOAS,DM38(31),
     *SGAMA,DM16( 75),TIME,DM17(5J),VA77F,
     *DM18(3),VG77F,DM37(23),XGW7F1,DM19(22),
     *YGW7F1,DM21(18),ZGW7F1,DM36(12J),AL2,DM65,
     *AL27S1,DM32(13),AM2,DM69,AM27S1,DM33(9),
     *AN2,DM66,AN277S,DM34(43),
     *U777F,DM24(33),XG77F,DM6J,XG77F1,DM61(11),
     *YG77F,DM62,YG77F1,DM63(11),ZG77F,DM64,ZG77F1,DM25(53)
      COMMON/DIRCOM/NSTRUT,DM26(26),RGR,NTIRES(5),
     *RZERO(5),DM27(13),MOMENT(5),DM28(85),MB(5),DM29(82),
     *DMT1(2),DMT2(2),DMT3(2),DMT4(2),DMT5(12),
     *DELTA1,DELTA2,DELTA3,DELTA4,DELTA5,DM30(14)
      COMMON/DIRCOM/
     1IN,ZN(5),YN(5),N(5),ICS,GDCH,SSH,XCH,YCH,ZCH,
     2IJ(5),ITO,HF,NF,XRF,HRF,DELTAH,KP,TI,NLRI,VS,XS,TS,
     3VATO,ALPHIO,HS,ALPDES,IAP,VD,DELVE,EPSGS,ALPHDS,ALPHOL,
     4HCG,DELEPS,RFH,PGS,DELSIG,RFY,PHIC,TTD,XTD,HTD,VXTD,
     5VHTD,IIR,LD,CA,TL,TU,KE(5),PM,TSP,TRV,TCH,TBK,ISS,
     6ILR,IBS,IC(5),XRF1,IT1(5),XRF2,IT2(5),H1,IH1(5),
     7H2,IH2(5),HR1,IHR1(5),HR2,IHR2(5),TR1,ITR1(5),
     8TR2,ITR2(5),TBK1,IBK1(5),TBK2,IBK2(5),DELQN,
     9RFALPH,DELALA,PSH,TST,DELQF,DELFD1,DELQTO,DELQL,DELQU,INOLG
      COMMON/DIRCOM/
     1RFB,DELBA,PSA,RFPSI,DPSIA,PSPSI,DELRL,DELRU,RFPHI,DPHIA,
     2PSA,DELPL,DELPU,TF(5),NDF(5),IR(5),NB(5),NLR(5),NTO(5),K2,
     3K3(5),K4(11),MBC(5),PD,DELTAW,OMEGD1,DM67(4),MBL(5),MBU(5),
     4DELHS,DELRRD,DELA,NED1,HR,DELQDC,DM68,RFALP2,PSH2,
     *DELQC,DELQC2,ALPDL,DM31(9),XR,XRD1,HRD1,DELQI,DM39(44),
     *DDM40(2J68)
C
C          INPUT REQUIRED FROM LGEAR
C     RG11, RG13, RG31, RG33
C
      COMMON/LGAUTS/RG11,RG13,RG31,RG33,MA(5),VAXLE(5)
C
C          OUTPUT GENERATED
C     XR, YR, ZR  - C.G. POSITION RELATIVE TO RUNWAY COORDINATE SYSTEM
C     XRD1, YRD1, ZRD1, - VELOCITY IN RUNWAY COORDINATE SYSTEM
C     HR, HRD1 - ALTITUDE AND ALT. RATE IN RUNWAY COORDINATE SYSTEM
C     PSIPD1 - YAW RATE IN EARTH AXES FOR P-Y-R SEQUENCE
C     PHIPD1 - ROW RATE IN EARTH AXES FOR P-Y-R SEQUENCE
C
      COMMON/AUTSC/TR,TC,TDX,
     1TDA,TDB,TD(5),IRA,IRB,IRC,ICA,ICB,
     2KA,KB,KEA,KEB,KT,NA,NNB,NC,ND(5),NBA,NBB,NBC,
     3NLRA,NLRB,NLRC,NDA,NDB,NDC,NTOA,NTOB,NTOC
```

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C
      REAL KA,KB,NA,NNB,NC,ND,NBA,NBB,NBC,NLRA,
     1NLRB,NLRC,NDA,NDB,NDC,NTOA,NTOB,NTOC,
     2MBC,MBL,MAU,MB,NTIRES,MOMENT,MA,LR,N,NED1,
     3NU1,ISS
C
      COMMON/AUTPRC/YR,ZR,YRD1,ZRD1,PSIPD1,PHIPD1,
     1VE,VAD,GAMPRL,QR,CLP,COR,LR,DR,HGS,RR,HEA,HE,
     2HET,HPA,HPT,PHIDES,TX,TH,XRFD1,HRFD1,AXR,AHR,
     3ALPHAE,ALDD1,ALPHET,DELRN,BETAET,DELRDE,DH,
     4PHIE,PHIET,DELPDE,DELQE1,DELRD1,DELPD1,
     5ND1(5),OMEGTR(5),OMTRD1(5),OMEGTE(5),PSIE,PSIET
      COMMON/EXEAUT/ADD1H1,SWT1,TIME1,ALPDD1,PNDES(5)
      COMMON/AUTSAC/ALPOR1,QDESR,CLRR,ALPD,CORR,DELRNN
C
C     POSITION AND VELOCITY RELATIVE TO RUNWAY COORDINATE SYSTEM
C
      LOGICAL SWT1,SWT2
      DIMENSION DELTA(5),OMET(2,5)
      EQUIVALENCE (DELTA1,DELTA(1)),(OMT1(1),OMET(1,1))
      DATA RADDEG,DEGRAD/57.2957795,.01745329/
      IPR=1
      GO TO 2
      ENTRY AUTSPR
      IPR=2
 2    DELTS=TIME-TIME1
      TIME1=TIME
      XR=RG11*(XG77F-RGR)+RG13*ZG77F
      YR=YG77F
      ZR=RG31*(XG77F-RGR)+RG33*ZG77F
      XRD1=RG11*XG77F1+RG13*ZG77F1
      YRD1=YG77F1
      ZRD1=RG31*XG77F1+RG33*ZG77F1
      HR=-ZR
      HRD1=-ZRD1
C
C     EULER ANGLE DER. FOR PITCH, YAW, ROLL SEQUENCE
C
      PSIPD1=0.
      IF((1.-AL2*AL2).LT.0.)GO TO 1
      PSIPD1=AL27S1/SQRT(1.-AL2*AL2)
 1    PHIPD1=(AN2*AM27S1/AM2-AN277S)/(AM2*(1.+(AN2/AM2)**2))
      IF(IPR.EQ.1)CALL AUTPR1
C
C          L O G I C  T O  D E T E R M I N E  P R O B L E M  P H A S E
C
C          INPUT REQUIRED(FROM DIRCOM)
C     ITO    = 1, FOR LANDING
C     ITO    NOT = 1, FOR TAKE OFF
C     HF     FLARE ALTITUDE
C     NF     INDICATOR TO STOP AT END OF GLIDE SLOPE(NF=1)
C     XRF, HRF - INITIAL VALUES OF DESIRED TOUCHDOWN POINT
C        IN RUNWAY COORDINATE SYSTEM
C     DELTAH- ALTITUDE ABOVE HRF FOR HOLD MODE
C     KP     - IMPACT INDICATOR
C     TI     - IMPACT TIME SET, IF KP=0, NO TI NEEDED
C     NLRI   - INDICATOR TO STOP AT IMPACT
C            =1, STOP AT IMPACT
C     VS, XS, TS  - RUNWAY STOPPING CONDITIONS
C     VATO   - AIRSPEED FOR TAKEOFF
C     ALPHTO- ANGLE OF ATTACK FOR TAKEOFF
C     HS     - ALTITUDE ABOVE RUNWAY TO TERMINATE TAKEOFF
C
C          INPUT REQUIRED FROM LGEAR(DIRCOM)
C     DELTA1,DELTA2,DELTA3,DELTA4,DELTA5 - TIRE DEFLECTION FOR EACH GEAR
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```
C
C           INPUT FROM SDF2(DIRCOM)
C       TIME, HGC7F, NSTRUT
C
        IF(ITO.NE.0)GO TO 20
        IF(HGC7F.GE.HF)GO TO 70
        IF(NF.EQ.1)GO TO 14
        IF((XR.GE.XRF).OR.(HR.LE.(HRF+DELTAH)))GO TO 13
C       CALL FLARE(ENTRY 1)
        CALL FLARE1(IPR)
C
C       CALL ENGINE FAILURE LOGIC
C
        CALL ENGFL
C       GO TO PITCH AUTOPILOT
        GO TO 90
   13   IF(KP.EQ.1)GO TO 10
        DO 11 I=1,NSTRUT
        IF(DELTA(I).GT.0.)GO TO 12
   11   CONTINUE
C       CALL FLARE(ENTRY 2)
        CALL FLARE2(IPR)
C
C       CALL ENGINE FAILURE LOGIC
C
        CALL ENGFL
C       GO TO PITCH AUTOPILOT
        GO TO 90
   12   KP=1
        TI=TIME
   10   IF(NLRI.EQ.1)GO TO 16
        IF((XRD1.LT.VS).OR.(XR.GT.XS).OR.
       C((TIME-TI).GT.TS))GO TO 16
C       GO TO LANDING ROLL
        GO TO 80
   14   WRITE(6,15)
   15   FORMAT(10X,18HEND OF GLIDE SLOPE)
        INDSTE=0
        RETURN
   16   WRITE(6,17)
   17   FORMAT(10X,21HAIRCRAFT HAS IMPACTED)
        INDSTE=0
        RETURN
C
C             G L I D E   S L O P E
C
C           INPUT REQUIRED FOR GLIDE SLOPE(FROM DIRCOM)
C       VD     - DESIRED INERTIAL VELOCITY DOWN THE GLIDE SLOPE
C       DELVE  - ALLOWED ERROR IN VE
C       EPSGS  - GLIDE SLOPE ELEVATION ANGLE
C       ALPHDS- LOWER LIMIT ON ALPHA
C       ALPHDL- UPPER LIMIT ON ALPHA
C       TTO    - DESIRED THRUST(INPUT ONLY IF IAP GREATER OR =3)
C       HCG    - DISTANCE BETWEEN WHEEL BOTTOM SURFACE AT C.G.
C       DELEPS- ALLOWED ANGULAR ERROR IN GLIDE SLOPE VERTICAL
C                POSITION FROM ORIGIN
C       RFH    - RATE FEED BACK CONTRIBUTION TO HET
C       PGS    - PHNGOID CONTROL SENSITIVITY
C       DELSIG- ALLOWED ANGULAR ERROR IN GLIDE SLOPE
C                HORIZONTAL POSITION FROM ORIGIN
C       RFY    - RATE FEED BACK CONTRIBUTION TO HPT
C       PHIC   - CONSTANT EULER ROLL ANGLE FOR CROSS RANGE CONTROL
C
C           INPUT FROM SDF2(DIRCOM)
C       VG77F, RHOAS, AMASS, GREFF, AREFF, XGH7F1, YGH7F1
```

```
C       ZGW7F1, HGC7F, XG77F, YG77F, ZG77F
C            INPUT FROM SUF2
C       XG77F1, YG77F1, ZG77F1
C
C            INPUT FROM LGEAR (DIRCOM)
C       RGR
C
C            OUTPUT GENERATED BY GLIDE SLOPE
C       VE     -GLIDE SLOPE INERTIAL VELOCITY ERROR
C       VAD    -DESIRED AIRSPEED IN GLIDE SLOPE
C       IAP    -PROBLEM PHASE INDICATOR
C       GAMMPR-FLIGHT PATH ANGLE FOR VAD
C       QR     -DYNAMIC PRESSURE AT VAD
C       CLR    -REQUIRED LIFT COEFFICIENT IN GLIDE SLOPE
C       CDR    -DRAG COEFFICIENT ASSOCIATED WITH CLR
C       LR     -LIFT AT CLR AND QR
C       DR     -DRAG AT CDR AND QR
C       THETAR -EULER PITH ANGLE FOR REQUIRED GLIDE SLOPE CONDITIONS
C       TTD    -DESIRED THRUST
C       HGS    -DESIRED GLIDE SLOPE ALTITUDE
C       RR     -DISTANCE TO GLIDE SLOPE ORIGIN
C       HEA    -GLIDE SLOPE VERTICAL POSITION ERROR ALLOWED
C       HE     -ACTUAL GLIDE SLOPE POSITION ERROR
C       HED1   -RELATIVE RATE LEAVING GLIDE SLOPE
C       HET    -TOTAL GLIDE SLOPE POSITION ERROR
C       HPT    -TOTAL GLIDE SLOPE HORIZONTAL POSITION ERROR
C       HPA    -GLIDE SLOPE HORIZONTAL POSITION ERROR ALLOWED
C       PHIDES-DESIRED EULER ROLL ANGLE
C
 70     IAP=1
        VE=VG77F-VD
        TMP1=EPSGS*DEGRAD
        IF(ABS(VE).LE.DELVE)GO TO 71
        TMP2=VD*COS(TMP1)-XGW7F1
        TMP3=VD*SIN(TMP1)-ZGW7F1
        VAD=SQRT(TMP2*TMP2+YGW7F1*YGW7F1+TMP3*TMP3)
        GAMMPR=ATAN(-TMP3/TMP2)
        GAMPRD=GAMMPR*RADDEG
        QR=.5*RHOAS*VAD*VAD
        CLR=AMASS*GREFF/(QR*AREFF)
        SWT2=.FALSE.
        QDESR=..
 76     DO 75 I=1,5
        ALPD=ALPDES
        CALL SACS1.
        CLRR=CLR
        CALL SACS8
        ALPDES=ALPD
        CDR=CDRR
 75     CONTINUE
        LR=CLR*QR*AREFF
        DR=CDR*QR*AREFF
        THETAR=GAMMPR+ALPDES*DEGRAD
        TTD=(LR*SIN(GAMMPR)+DR*COS(GAMMPR))/COS(THETAR)
        IF(SWT2)GO TO 71
        CLR=(AMASS*GREFF+DR*SIN(GAMMPR)-TTD*SIN(THETAR))/
       C(COS(GAMMPR)*QR*AREFF)
        SWT2=.TRUE.
        GO TO 76
 71     HGS=ABS(XG77F-RGR)*TAN(TMP1)+HGP
        RR=SQRT((XG77F-RGR)**2+ZG77F*ZG77F)
        HEA=RR*DELEPS*DEGRAD
        HE=HGC7F-HGS
        HED1=-ZG77F1+XG77F1*TAN(TMP1)
        HET=HE+RFH*HED1
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      IF(ABS(HET).GE.HEA)ALPDES=ALPDES-PGS*HET
      IF(ALPDES.LT.ALPHDS)ALPDES=ALPHDS
      IF(ALPDES.GT.ALPHDL)ALPDES=ALPHDL
      HPA=RR*DELSIG*DEGRAD
      HPT=YG77F+KFY*YG77F1
      IF(HPT.GT.HPA)GO TO 72
      IF(HPT.LT.(-HPA))GO TO 73
      PHIDES=J.
      GO TO 74
 72   PHIDES=-PHIC
      GO TO 74
 73   PHIDES=PHIC
C
C     CALL ENGINE FAILURE LOGIC
C
 74   CALL ENGFL
      IF(IPR.EQ.1)CALL AUTPR2
C     GO TO PITCH AUTOPILOT
      GO TO 9J
C
C            T A K E   O F F   R O L L
C
C            INPUT REQUIRED(FROM DIRCOM)
C     VATO   -AIRSPEED FOR TAKEOFF
C     ALPHTO-ANGLE OF ATTACK FOR TAKEOFF
C     HS     -ALTITUDE ABOVE RUNWAY TO TERMINATE TAKEOFF
C
C           INPUT FROM SDF2(DIRCOM)
C     VA77F
C
C           OUTPUT GENERATED
C     ALPDES- DESIRED ANGLE OF ATTACK(INPUT WHEN IAP GREATER OR =3)
C     IAP    -PROBLEM PHASE INDICATOR
C
 20   IAP=5
      IF(VA77F.LT.VATO)GO TO 21
      IAP=6
      ALPDES=ALPHTO
 21   IF(HR.GT.HS)GO TO 22
C     CALL ENGINE FAILURE LOGIC
      CALL ENGFL
C     GO TO PITCH AUTOPILOT
      QDESR=J.
      GO TO 90
 22   WRITE(6,23)HR,HS
 23   FORMAT(1H0,5X,42HALTITUDE ABOVE RUNWAY TO TERMINATE TAKEOFF/
     *6X,5HHR = E15.8,10X,5HHS = E15.8)
      INDSTE=0
      RETURN
C
C            L A N D I N G   R O L L
C
C           INPUT REQUIRED FOR LANDING ROLL(FROM DIRCOM)
C     TSP    - TIME AFTER IMPACT TO STAGE SPOILERS
C     TRV    - TIME AFTER IMPACT TO REVERSE SIGNAL
C     TCH    - TIME AFTER IMPACT TO CHUTE SIGNAL
C     TBK    - TIME AFTER IMPACT TO BRAKE SIGNAL
C     ISS = 0., SPOILER SIGNAL INITIALIZATION
C     ILR = 0, REVERSE SIGNAL INITIALIZATION
C     ICS = 0, CHUTE SIGNAL INITIALIZATION
C     IBS=0, BRAKE SIGNAL INITIALIZATION
C
C
C            INPUT FROM SDF2(DIRCOM)
C     TIME
```

```
C
C        OUTPUT GENERATED
C     ISS=1., ILR=1, ICS=1, IBS=1, IAP=4
C
 80   IAP=4
      TR=TIME-TI
      TRK=TP
      IF(TR.GE.TSP)ISS=1.
      IF(TR.GE.TRV)ILR=1
      IF(TR.GE.TCH)ICS=1
      IF(TR.GE.TBK)GO TO81
      IF(IPR.EQ..)CALL AUTPR4
      GO TO 18
 81   IBS=1
      IF(IPR.EQ..)CALL AUTPR4
C
C          B R A K E   F A I L U R E   L O G I C
C
C        INPUT REQUIRED FOR BRAKE FAILURE LOGIC(FROM DIRCOM)
C     TBK1  - FIRST TIME AFTER IMPACT TO STAGE BRAKE CONDITIONS
C     IBK1(I) ARRAY ASSOCIATED WITH TBK1
C     TBK2  - SECOND TIME AFTER IMPACT TO STAGE BRAKE CONDITIONS
C     IBK2(I) ARRAY ASSOCIATED WITH TBK2
C     NSTRUT- NO. OF STRUTS
C
C        OUTPUT GENERATED FOR LGEAR AND AUTS
C     IB(I) -
C
      IF(TR.LT.TBK1)GO TO 25
      DO 19 I=1,NSTRUT
 19   IB(I)=IBK1(I)
 25   IF(TR.LT.TBK2)GO TO 18
      DO 26 I=1,NSTRUT
 26   IB(I)=IBK2(I)
C
C     CALL ENGINE FAILURE LOGIC
C
 18   CALL ENGFL
C
C          P I T C H   A U T O P I L O T
C
C         INPUT REQUIRED FOR PITCH AUTOPILOT(PIRCOM)
C     DELON -NOMINAL HORIZONTAL STABILIZER TRIM POSITION
C     RFALPH-RATE FEED BACK FOR ALPHRE
C     DELALA-ERROR ALLOWED IN ALPHA CONTROL
C     PSH    -PILOT SENSITIVITY IN ALPHA OVER CONTROL
C     TST    -TIME AFTER IMPACT AT WHICH NOSE OVER BEGINS
C     DELQF -FINAL DELQD ON END OF NOSE OVER
C     DELFD1-HORIZONTAL STABLIZER RATE COMMAND IN ACHIEVING DELQF
C     DELQTO-HORIZONTAL STABLIZER POSITION FOR TAKE OFF
C     DELQL -LOWER LIMIT ON DELQDE
C     DELQU -UPPER LIMIT ON DELQDE
C     IAP    -PROBLEM PHASE INDICATOR
C
C         INPUT FROM SUF2(DIRCOM)
C     DELTS, ALPHR1, ALPHD
C
C        OUTPUT GENERATED BY PITCH AUTOPILOT
C     DELON -NOMINAL HORIZONTAL STABILIZER TRIM POSITION
C     ALPHAE-ANGLE OF ATTACK POSITION ERROR
C     ALFDD1-RATE OF CHANGE OF ALPDES
C     ALPHRE-ANGLE OF ATTACK RELATIVE RATE ERROR
C     ALPHET-TOTAL ANGLE OF ATTACK ERROR
C     DELQDE-DESIRED HORIZONTAL STABILIZER POSITION(DIRCOM)
C
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      IF(IAP.EQ.4)GO TO 93
      IF(IAP.EQ.5)GO TO 91
      ALPD=ALPDES
      CALL SACS10
      IF(IAP.LT.2)GO TO 97
      RFALPH=RFALP2
      PSH=PSH2
      DELQC=DELQC2
97    ALPHAE=ALPHD-ALPDES
      IF(DELTS.LE.1.E-6)GO TO 96
      ALPDD1=(ALPDES-AD01M1)/DELTS
      IF(ABS(ALPDD1).GT.ALPDL)ALPDD1=0.
96    AD01M1=ALPDES
      ALD01=ALPDD1
      ALPHRE=ALPHR1*RADDEG-ALPDD1
      ALPHET=ALPHAE+RFALPH*ALPHRE
      DELQDE=DELQN
      SIGNN=SIGN(1.,ALPHAE)
      IF(ABS(ALPHET).GE.DELALA)DELQDE=DELQN+PSH*ALPHET+SIGNN*DELQC
      GO TO 92
93    IF(TR.LE.TST)GO TO 95
      TMP1=DELFD1*(TR-TST)
      IF((DELQI-DELQF).GE.0.)GO TO 94
      DELQDE=DELQI+TMP1
      IF(DELQDE.GE.DELQF) DELQDE=DELQF
      GO TO 92
95    DELQI=DELQDE
      GO TO 92
94    DELQDE=DELQI-TMP1
      IF(DELQDE.LE.DELQF) DELQDE=DELQF
      GO TO 92
91    DELQDE=DELQTO
92    IF(DELQDE.LE.DELQL) DELQDE=DELQL
      IF(DELQDE.GE.DELQU) DELQDE=DELQU
      IF(IPR.EQ.0)CALL AUTPR5
C
C          Y A W   A U T O P I L O T
C
C          INPUT REQUIRED FOR YAW AUTOPILOT(DIRCOM)
C     RFB   -RATE FEED BACK FOR SIDESLIP
C     DELBA -SIDE SLIP ERROR ALLOWED
C     PSR   -PILOT SENSITIVITY IN SIDE SLIP OVER CONTROL
C     RFPSI -RATE FEED BACK FOR PSIE
C     DPSIA -EULER YAW ERROR ALLOWED
C     PSPSI -PILOT SENSITIVITY IN EULER YAW CONTROL
C     DELRL -LOWER RUDDER LIMIT ON DELRDE
C     DELRU -UPPER RUDDER LIMIT ON DELRDE
C     IAP   -PROBLEM PHASE INDICATOR
C
C          INPUT FROM SDF2(DIRCOM)
C     BETAD,BETAR1,PSIPD
C
C         OUTPUT GENERATED BY YAW AUTOPILOT
C     DELRN -NOMINAL RUDDER TRIM POSITION
C     BETAE -SIDESLIP POSITION ERROR
C     BETAET-TOTAL SIDE SLIP ERROR
C     DELRDE-DESIRED RUDDER POSITION
C     PSIE  -EULER YAW ANGLE POSITION ERROR
C     PSIET -TOTAL EULER YAW POSITION ERROR
C
      CALL SACS11
      DELRN=DELRNN
      IF(IAP.GT.2)GO TO 100
      BETAE=BETAD
      BETAET=BETAE+RFB*BETAR1*RADDEG
```

```
      DELRDE=DELRN
      IF(ABS(BETAET).GE.DELRA)DELRDE=DELRN+PSR*BETAET
      GO TO 101
 100  PSIE=PSIPO
      PSIET=PSIE+RFPSI*PSIPO1*RADDEG
      DELRDE=DELRN
      IF(ABS(PSIET).GE.DPSIA)DELRDE=DELRN+PSPSI*PSIET
 101  IF(DELRDE.LT.DELRL)DELRDE=DELRL
      IF(DELRDE.GT.DELRU)DELRDE=DELRU
      IF(IPR.EQ.0)CALL AUTPR6
C
C          R O L L   A U T O P I L O T
C
C          INPUT REQUIRED FOR ROLL AUTOPILOT(DIRCOM)
C     RFPHI -ROLL ANGLE RATE FEEDBACK
C     DPHIA -ROLL ANGLE ERROR ALLOWED
C     PSA   -PILOT SENSITIVETY IN ROLL OVER CONTROL
C     DELPL -LOWER AILERON LIMIT ON DELPDE
C     DELPU -UPPER AILERON LIMIT ON DELPDE
C     IAP   -PROBLEM PHASE INDICATOR
C
C          INPUT FROM SOF2(DIRCOM)
C     PHIPO
C
C         OUTPUT GENERADED BY ROLL AUTOPILOT
C     PHIE  -ROLL ANGLE ERROR
C     PHIET -TOTAL ROLL ANGLE ERROR
C     DELPDE-DESIRED AILERON POSITION
C
      IF(IAP.GT.3)GO TO 102
      PHIE=PHIPO-PHICES
      PHIET=PHIE+RFPHI*PHIPO1*RADDEG
      IF(ABS(PHIET).LT.DPHIA)GO TO 102
      DELPDE=PSA*PHIET
      GO TO 103
 102  DELPDE=0.
 103  IF(DELPDE.LT.DELPL)DELPDE=DELPL
      IF(DELPDE.GT.DELPU)DELPDE=DELPU
      IF(IPR.EQ.0)CALL AUTPR7
C
C     CALL THROTTLE AUTOPILOT
C
 33   CALL THAUTS(IPR)
C
C          B R A K E   A U T O P I L O T
C
C         INPUT REQUIRED (FROM DIRCOM)
C     MBC(I)- BRAKING CONSTANT FOR STRUT I
C     PD    - PER CENT SKID FOR CONTROLLED BRAKING
C     DELTAW- PER CENT SPEED ERROR ALLOWED
C     OMEGD1(I)-ACCELERATION TO OMEGTR(I) DESIRED
C     MBL(I)- LOWER BRAKING MOMENT ALLOWED FOR STRUT I
C     MBU(I)- UPPER BRAKING MOMENT ALLOWED FOR STRUT I
C     MB(I) - BREAKING MOMENT INITIALLY READ IN
C     NSTRUT- NUMBER OF INDEPENDENT STRUTS(LGEAR MOD)
C     RZERO(I)- RADIUS OF TIRES ON EACH STRUT(LGEAR MOD)
C     NTIRES(I) - NUMBER OF TIRES ON EACH STRUT(LGEAR MOD)
C     MOMENT(I) - MOMENT OF INERTIA OF SINGLE ROTATING
C                 WHEEL ON EACH STRUT(LGEAR MOD)
C     DELTA(I) - TIRE DEFLECTION FOR EACH GEAR(LGEAR MOD)
C
C         OUTPUT GENERATED
C     OMEGTR(I) - DESIRED WHEEL SPEED FOR PD FOR STRUT I
C     OMTRD1(I) - DESIRED WHEEL SPEED DECELLER FOR STRUT I
C     OMEGTE(I) - WHEEL SPEED ERROR FOR STRUT I
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```
C      MB(I)      - BRAKING MOMENT FOR STRUT I
C
C         OUTPUT GENERATED FOR LGEAR (IN DIRCOM)
C      OMET(1,I),
C
C
C         INPUT REQUIRED (FROM LGEAR)
C      MA(I),OMET(1,I),VAXLE(I)
C
C          INPUT REQUIRED SDF2(DIRCOM)
C      AMASS, FX37P
C
       DO 40 I=1,NSTRUT
       IF(IBS.NE.1)GO TO 41
       IF(IB(I))42,43,44
 42    OMET(1,I)=0.
       GO TO 41
 43    MB(I)=0.
       GO TO 41
 44    IF(IB(I).GT.1)GO TO 45
       TMP1=-(1.-PO)/(RZERO(I)-DELTA(I))
       OMEGTR(I)=VAXLE(I)*TMP1
       OMTRO1(I)=FXB7P*TMP1/AMASS
       OMEGTE(I)=OMET(1,I)-OMEGTR(I)
       TMP1=0.
       IF(ABS(OMET(1,I)).LE.1.E-10)GO TO 48
       TMP1=ABS(OMET(1,I))/OMET(1,I)
 48    IF(ABS(OMEGTE(I)).LT.ABS(DELTAW*OMEGTR(I)))GO TO 46
       IF(OMEGTE(I).GT.0.)GO TO 47
       MB(I)=TMP1*(MA(I)-OMECD1*MOMENT(I)*NTIRES(I))
       GO TO 41
 45    MB(I)=MBC(I)
       GO TO 41
 46    MB(I)=TMP1*(MA(I)-OMTRO1(I)*MOMENT(I)*NTIRES(I))
       GO TO 41
 47    MB(I)=TMP1*(MA(I)+OMECD1*MOMENT(I)*NTIRES(I))
 41    IF(MB(I).LT.MBL(I))MB(I)=MBL(I)
       IF(MB(I).GT.MBU(I))MB(I)=MBU(I)
 40    CONTINUE
       IF(IPR.EQ.0)CALL AUTPR9
C
C          C O N T R O L    R E S P O N S E
C
C         INPUT REQUIRED(FROM DIRCOM)
C      DELPD - CONTROL SURFACE DEFLECTION(INPUT AND OUTPUT)
C      DELQD - CONTROL SURFACE DEFLECTION(INPUT AND OUTPUT)
C      DELRD - CONTROL SURFACE DEFLECTION(INPUT AND OUTPUT)
C      DELHS - HORIZONTAL STABLIZER TIME RATE
C      DELRRD- RUDDER TIME RATE
C      DELA  - AILERON TIME RATE
C      NED1  - ENGINE TIME RATE
C      IN    - NO. OF ENGINES
C      DELTS - MAXIUM INTEGRATION INTERVAL
C      N(I)  - THROTTLE POSITION FOR EACH INGINE(INPUT AND OUTPUT)
C
       DELQD1=DELHS
       IF(DELQDE.LT.DELQD)DELQD1=-DELHS
       DELRD1=DELRRD
       IF(DELRDE.LT.DELRD)DELRD1=-DELRRD
       DELPD1=DELA
       IF(DELPDE.LT.DELPD)DELPD1=-DELA
       DO 50 I=1,IN
       IF(ND(I).EQ.0.)GO TO 51
       IF(SWT1)GO TO 52
       IF(ND(I))56,58,58

       IF(PNDES(I))52,59,59
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```
      IF(PNDES(I))59,52,52
59    N(I)=-N(I)
52    IF(NO(I)-N(I))53,54,54
53    NO1(I)=-NED1
      GO TO 50
54    NO1(I)=NED1
      GO TO 50
51    N(I)=0.
      NO1(I)=0.
50    CONTINUE
      SHT1=.FALSE.
      DO 55 I=1,IN
55    PNDES(I)=ND(I)
      IF(ABS(DELQD1*DELTS).GE.ABS(DELQDE-DELQD))GO TO 60
      DELQD=DELQD+DELQD1*DELTS
      GO TO 61
60    DELQD=DELQDE
61    IF(ABS(DELRD1*DELTS).GE.ABS(DELRDE-DELRD))GO TO 62
      DELRD=DELRD+DELRD1*DELTS
      GO TO 63
62    DELRD=DELRDE
63    IF(ABS(DELPD1*DELTS).GE.ABS(DELPDE-DELPD))GO TO 64
      DELPD=DELPD+DELPD1*DELTS
      GO TO 65
64    DELPD=DELPDE
65    DO 67 I=1,IN
      IF(ABS(ND1(I)*DELTS).GE.ABS(ND(I)-N(I)))GO TO 66
      N(I)=N(I)+ND1(I)*DELTS
      GO TO 67
66    N(I)=ND(I)
67    CONTINUE
      IF(IPR.EQ.0)CALL AUTP10
      RETURN
      END
      SUBROUTINE FLARE1(IPR)
      EXTERNAL ASIN
C
C                 F L A R E
C
C          INPUT REQUIRED(FROM DIRCOM)
C     XTD    - INITIAL SELECTED TOUCHDOWN CONDITIONS
C     HTD    - INITIAL SELECTED TOUCHDOWN CONDITIONS
C     VXTD   - INITIAL SELECTED TOUCHDOWN CONDITIONS
C     VHTD   - INITIAL SELECTED TOUCHDOWN CONDITIONS
C     IIR    - IF=0,INITIALLY SET XRF, HRF, XRFD1, HRFD1 TO XTD,
C              HTD, VXTD, VHTD
C     LD     - SUSPECTED LANDING DISTANCE
C     DA     - NUMBER OF INCREMENTS/DEG IN ALPHA SEARCH
C     TL     - LOWER THRUST LIMIT ALLOWED IN FLARE
C     TU     - UPPER THRUST LIMIT ALLOWED IN FLARE
C     PH     - MAX. TAIL DOWN INTERFERENCE ANGLE AT TOUCHDOWN
C     ALPHDS- LOWER LIMIT ON ALPHA
C     ALPHDL- UPPER LIMIT ON ALPHA
C     HR
C
C          INPUT REQUIRED(FROM LGEAR-DIRCOM)
C     RLT    - RUNWAY LENGTH(USED ALSO IN LGEAR)
C     ERDEG  - RUNWAY ELEVATION ANGLE IN DEG(USED ALSO IN LGEAR)
C
C          INPUT REQUIRED(FROM SDF2-DIRCOM)
C     AMASS,DYNPP,AREFF,WTR7P
C     SGAMA,GAM7D,VG77F
C
      COMMON/DIRCOM/DM1(136),AMASS,DM2(25),AREFF,
     *DM3(191),DYNPP,DM19(58),GAM7D,DM4(391),
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     *SGAMA,DM13(130),VG77F,DM18(18),HTR7P,DM5(365)
      COMMON/DIRCOM/DM5(26),ERDEG,DM7(116),RLT,DM8(120)
      COMMON/DIRCOM/DM9(30),XRF,HRF,DM15(10),ALPDES,IAP,DM16(3),
     *ALPHOS,ALPHOL,DM10(7),TTD,XTD,HTD,
     *VXTD,VHTD,IIR,LD,DA,TL,TU,DM11(5),PM,DM12(169),HR,DM14(16),
     *XR,XRD1,HRD1,DM17(45),DDM20(2068)
C
C         INPUT REQUIRED(FROM AUTS)
C     XR, XRD1, HRD1
C
C          OUTPUT GENERATED BY FLARE1
C     XRF    - ACTUAL SELECTED TOUCHDOWN CONDITIONS(DIRCOM)
C     HRF    - ACTUAL SELECTED TOUCHDOWN CONDITIONS(DIRCOM)
C     XRFD1  - ACTUAL SELECTED TOUCHDOWN CONDITIONS
C     HRFD1  - ACTUAL SELECTED TOUCHDOWN CONDITIONS
C     TX     - TIME TO TOUCHDOWN X CONSTRAINT
C     TH     - TIME TO TOUCHDOWN Y CONSTRAINT
C     DM     - INCREASE OF TOUCHDOWN POINT PAST XTD.
C     RSR    - TOUCHDOWN ALTITUDE RATE REQUIRED TO MEET TX=TH CONSTRAINT
C     AXR    - REQUIRED ACCELERATION TO MEET TOUCHDOWN CONDITIONS
C     AHR    - REQUIRED ACCELERATION TO MEET TOUCHDOWN CONDITIONS
C     GAMAPD- AIRSPEED FLIGHT PATH ANGLE RELATIVE TO RUNWAY
C     TTD    - REQUIRED THRUST SATISFY AXR(DIRCOM)
C     IAP    - PROBLEM PHASE INDICATOR (DIRCOM)
C     ALPDES- DESIRED ANGLE OF ATTACK(DIRCOM)
C
      COMMON/AUTSC/TR,TC,TDX,
     1TDA,TDB,TD(5),IRA,IRB,IRC,ICA,ICB,
     2KA,KB,KEA,KEB,KT,NA,NNB,NC,ND(5),NBA,NBB,NBC,
     3NLRA,NLRB,NLRC,NDA,NDB,NDC,NTOA,NTOB,NTOC
C
      COMMON/AUTPRC/YR,ZR,YRD1,ZRD1,PSIPD1,PHIPD1,
     1VE,VAD,GAMPRD,QR,CLR,CDR,LR,DR,HGS,RR,HEA,HE,
     2HET,HPA,HPT,PHIDES,TX,TH,XRFD1,HRFD1,AXR,AHR,
     3ALPHAE,ALPDD1,ALPHET,DELRN,BETAET,DELRDE,DM,
     4PHIE,PHIET,DELPDE,DELQD1,DELRD1,DELPD1,
     5ND1(5),OMEGTR(5),OMTRD1(5),OMEGTE(5),PSIE,PSIET
C
      COMMON/AUTSAC/ALPDR1,QDESR,CL1,A1,CD1,DELRNN
      LOGICAL SWT1
      REAL LD,L1
      DATA RADDEG,DEGRAD/57.2957795,.01745329/
      IAP=2
      IF(IIR.EQ.1)GO TO 10
      IIR=1
      XRF=XTD
      HRF=HTD
      XRFD1=VXTD
      HRFD1=VHTD
   10 TMP1=XRF-XR
      TMP2=XRD1+XRFD1
      TMP3=HRF-HR
      TMP4=HRFD1+HRD1
      TMP5=TMP3*TMP2/TMP4+XR-XTD
      TX=2.*TMP1/TMP2
      TH=2.*TMP3/TMP4
      IF(TX-TH)11,30,13
   11 DM=TMP5
      IF((LD+DM).GT.RLT)GO TO 14
      XRF=XTD+DM
      TMP1=XRF-XR
      GO TO 30
   14 XRF=XTD+RLT-LD
      TMP1=XRF-XR
      HRFD1=TMP2*TMP3/TMP1-HRD1
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      GO TO 30
23    DM=TMP5
      IF(DM.LT.0.)DM=0.
      XRF=XTD+DM
      TMP1=XRF-XR
      TX=2.*TMP1/TMP2
      IF(TX.LE.TH)GO TO 30
      RSR=2.*TMP3/TX-HRD1
      IF(RSR.GT.0.)GO TO 12
      HRFD1=RSR
      GO TO 30
12    HRFD1=0.
      XRFD1=HRD1*TMP1/TMP3-XRD1
30    TMP2=XRD1+XRFD1
      TMP4=HRFD1+HRD1
      AXR=(XRFD1-XRD1)*TMP2/(2.*TMP1)
      AHR=(HRFD1-HRD1)*TMP4/(2.*TMP3)
      GAMERR=(GAM7D-ERDEG)*DEGRAD
      TMP1=SIN(GAMERR)
      TMP2=COS(GAMERR)
      QDESR=ALPDR1+(AHR*TMP2-AXR*TMP1)/VG77F
      GAMMAD=ASIN(SGAMA)*RADDEG
      GAMAPD=GAMMAD-ERDEG
      GAMAPR=DEGRAD*GAMAPD
      TMP1=SIN(GAMAPR)
      TMP2=COS(GAMAPR)
      ERRAD=ERDEG*DEGRAD
      TMP3=WTR7P*SIN(ERRAD)
      TMP4=WTR7P*COS(ERRAD)
      TMP5=AMASS*AXR
      SWT1=.FALSE.
      A1=ALPHOS
C     CALL SACS TO FIND CL1 AND CD1 FOR ALPHA = A1
5     CALL SACS10
      CALL SACS9
      L1=CL1*DYNPP*AREFF
      D1=CD1*DYNPP*AREFF
      TMP6=DEGRAD*(A1+GAMAPD)
      TTH=(TMP5+L1*TMP1+D1*TMP2+TMP3)/COS(TMP6)
      IF(TTH.LT.TL)TTH=TL
      IF(TTH.GT.TU)TTH=TU
      IF(SWT1)GO TO 6
      TTD=TTH
      ALPDES=A1
6     AX=(TTH*COS(TMP6)-L1*TMP1-D1*TMP2-TMP3)/AMASS
      AH=(TTH*SIN(TMP6)+L1*TMP2-D1*TMP1-TMP4)/AMASS
      TAE=SQRT((AXR-AX)**2+(AHR-AH)**2)
      IF(SWT1)GO TO 7
      AE=TAE
      SWT1=.TRUE.
7     IF(TAE.GT.AE)GO TO 8
      AE=TAE
      TTD=TTH
      ALPDES=A1
8     A1=A1+DA
      IF(A1.LE.ALPHDL)GO TO 5
      PHIDES=0.
      IF(IPR.EQ.0)CALL AUTPR3
      RETURN
      ENTRY FLARE2
      GAMMAD=ASIN(SGAMA)*RADDEG
      GAMAPD=GAMMAD-ERDEG
      IAP=3
      PHIDES=0.
      IF((ALPDES+GAMAPD).GT.PM)ALPDES=PM-GAMAPD
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      IF(IPR.EQ.1)CALL AUTP11
      RETURN
      END
      SUBROUTINE AUTPR1
      COMMON/DIRCOM/DM1(116),ALPHO,DM2(3),ALPHR1,DM3(15),
     *AMASS,DM4(25),AREFF,DM5(11),BETAD,DM6(3),BETAR1,DM7(147),
     *DELPO,DM8,DELQO,DM9,DELRO,DM10,DELTS,DM11(59),FX07P,DM12(23),
     *GREFF,DM13(17),HGC7F,DM14(259),PHIPD,DM15(23),PSIPD,
     *DM35(54),RHOA,,DM36(31),
     *SGAMA,DM16( 75),TIME,DM17(50),VA77F,
     *DM18(3),VG77F,DM37(29),XGH7F1,DM19(22),
     *YGH7F1,DM21(18),ZGH7F1,DM36(12),AL2(2),
     *AL27S1(2),DM32(12),AM2(2),AM275'(2),DM33(8).,
     *AN2(2),AN277S(2),DM34(42),
     *U777F,DM24(33),XG77F(2),XG77F1( 2),
     *YG77F(2),YG77F1(12),ZG77F(2),ZG77F1(2),DM25(52)
      COMMON/DIRCOM/NSTRUT,DM26(26),RGR,NTIRES(5),
     *RZERO(5),DM27(10),MOMENT(5),DM28(45),MB(5),DM29(82),
     *OMT1(2),OMT2(2),OMT3(2),OMT4(2),OMT5(12),
     *DELTA1,DELTA2,DELTA3,DELTA4,DELTA5,DM30(14)
      COMMON/DIRCOM/
     1IH,ZN(5),YN(5),N(5),IGS,COCH,SSH,XCH,YCH,ZCH,
     2I3(5),ITG,HF,NF,XRF,HRF,DELTAH,SP,TI,NLRI,VS,XS,TS,
     3VATO,ALPHTO,HS,ALPDES,IAP,VD,DE.VE,EPSOS,ALPHDS,ALPHDL,
     4HCG,DELEPS,RFH,PGS,DELSIG,RFY,PHIS,TTD,XTD,HTD,VXTD,
     5VHTD,IIR,LD,DA,TL,TU,KE(5),PM,TSP,TRV,TCH,TBK,ISS,
     6ILR,INS,IC(5),XRF1,IT1(5),XRF2,IT2(5),H1,IH1(5),
     7H2,IH2(5),HR1,IHR1(5),HR2,IHR2(5),TR1,ITR1(5),
     8TR2,ITR2(5),TBK1,IBK1(5),TBK2,IBK2(5),DELQN,
     9RFALPH,DELALF,PSH,TST,DELQF,DELFD1,DELQTO,DELQL,DELQU,INDLG
      COMMON/DIRCOM/
     1RFD,DELBA,PSP,RFPSI,DPSIA,PSPSI,DELRL,DELRU,RFPHI,DPHIA,
     2PSA,DELPL,DELPU,TF(5),NDF(5),IR(5),NB(5),NLR(5),NTO(5),K2,
     3K3(5),K4(11),MBC(5),PD,DELTAH,OMEGD1(5),MBL(5),MBJ(5),
     4DELHS,DELRRD,DELA,NED1,HR,DELQOL,MANLOG,DM40(5),AUXICP,
     5PITCHP,YAWAUP,ROLLAP,BRAKAP,CONTRP,THROAP,INDICP,DM31,
     *XR,XRD1,HRD1,DM39(45),DOM41(2168)
      COMMON/AUTSC/TR,TC,TOX,
     1TOA,TOB,TD(5),IRA,IRB,IRC,ICA,ICB,
     2KA,KB,KEA,KEB,KT,NA,NNB,NC,NE(5),NRA,NBB,NBC,
     3NLRA,NLRB,NLRC,NOA,NOB,NOC,NTOA,NTOB,NTOC
      COMMON/AUTPRC/YR,ZR,YRD1,ZRD1,PSIPD1,PHIPD1,
     1VE,VAD,GAMPRD,QR,CLR,COR,LR,DR,HGS,RR,HEA,HE,
     2HET,HPA,HPT,PHIDES,TX,TH,XRF01,HRF01,AXP,AHR,
     3ALPHAE,ALPOD1,ALPHET,DELRN,BETAET,DELRDE,DH,
     4PHIE,PHIET,DELPDE,DELQD1,DELRD1,DELPD1,
     5ND1(5),OMEGTR(5),OMTRD1(5),OMEGTE(3),PSIE,PSIET
      INTEGER AUXICP,PITCHP,YAWAUP,ROLLAP,THROAP,BRAKAP,CONTRP
      REAL LP,ISS,NC,MB,ND1,N
      DIMENSION PRT1(8),PRT2(17),PRT3(16),PRT4(3),
     CPRT5(2),PRT6(6),PRT7(7),PRT8(3),PRT9(6)
      DATA TITLE/6HAUTS  /
      DATA
     1(PRT1(I),I=1,8)/2HXR,2HYR,2HZR,4HXRD1,4HYRD1,4HZRD1,6HPSIPD1,
     26HPHIPD1/,(PRT2(I),I=1,17)/2HVE,3HVAD,6HGAMMPR,2HQR,3HCLR,
     36HALPDES,2HLR,2HDR,2HTD,3HHGS,2HRR,3HHEA,2HHE,3HHET,
     43HHPA,3HHPT,6HPHIDES/,(PRT3(I),I=1,16)/2HTX,2HTH,
     53HXTD,3HHTD,4HVXTD,4HVHTD,3HXRF,5HXRFD1,3HHRF,
     65HHRFD1,3HAXP,3HAHR,6HALPDES,2HTD,6HPHIDES,2HDH/,
     7(PRT4(I),I=1,3)/6HALPDES,6HPHIDES,3HTTD/,
     8(PRT5(I),I=1,2)/2HTI,2HTR/,(PRT6(I),I=1,6)/5HDELQN,
     96HALPHAE,5HALPHD1,6HALPOD1,6HALPHET,6HDELQDE/,
     A(PRT7(I),I=1,7)/5HDELQR,5HBETAD,6HBETAD1,6HBETAET,
     B6HDELRDE,4HPSIE,5HPSIET/,(PRT8(I),I=1,3)/4HPHIE,5HPHIET,
     C6HDELPDE/,(PRT9(I),I=1,6)/6HDELQD1,6HDELRD1,6HDELPD1,
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C     D5HDELQD,5HDELRD,5HDELPD/
C
C     WRITE TITLE AND AUXILIARY COMPUTATIONS OF AUTS
C
      CALL STFL(3,1,TITLE)
      IF(AUXICP.EQ.0)RETURN
      CALL LINES(2)
      WRITE(6,10)
 10   FORMAT(55X,22HAUXILIARY COMPUTATIONS)
      CALL STFL(2,8,PRT1)
      PSPD1D=PSIPD1*57.2957795
      PHDD1D=PHIPD1*57.2957795
      CALL STOVAR(8,XR,YR,ZR,XRD1,YRD1,ZRD1,PSPD1D,PHDD1D)
      CALL STFL(0,1,DU)
      RETURN
C
C     GLIDE SLOPE PRINTOUT
C
      ENTRY AUTPR2
      IF(MANLOG.EQ.0)RETURN
      CALL LINES(1)
      WRITE(6,20)
 20   FORMAT(60X,11HGLIDE SLOPE)
      CALL STFL(2,8,PRT2)
      CALL STFL(2,8,PRT2(9))
      CALL STFL(2,1,PRT2(17))
      CALL STOVAR(8,VE,VAD,GAMPRD,QR,DLR,ALPDES,LR,DR)
      CALL STOVAR(8,TTD,HGS,RR,HEA,HE,HET,HPA,HPT)
      CALL STFL(1,1,PHIDES)
      CALL STFL(0,1,DU)
      RETURN
C
C     FLARE ENTRY NUMBER 1
C
      ENTRY AUTPR3
      IF(MANLOG.EQ.0)RETURN
      CALL LINES(1)
      WRITE(6,30)
 30   FORMAT(63X,5HFLARE)
      CALL STFL(2,8,PRT3)
      CALL STFL(2,8,PRT3(9))
      CALL STOVAR(8,TX,TH,XTD,HTD,VXTD,VHTD,XRF,XRFD1)
      CALL STOVAR(8,HRF,HRFD1,AXR,AHR,ALPDES,TTD,PHIDES,DM)
      CALL STFL(0,1,DU)
      RETURN
C
C     FLARE ENTRY NUMBER 2
C
      ENTRY AUTP11
      IF(MANLOG.EQ.0)RETURN
      CALL LINES(1)
      WRITE(6,30)
      CALL STFL(2,3,PRT4)
      CALL STOVAR(3,ALPDES,PHIDES,TTD,DU,DU,DU,DU,DU)
      CALL STFL(0,1,DU)
      RETURN
C
C     ENTRY FOR PRINTING LANDING ROLL DATA
C
      ENTRY AUTPR4
      IF(MANLOG.EQ.0)RETURN
      CALL LINES(2)
      WRITE(6,40)ISS,ILR,ICS,IBS
 40   FORMAT(60X,12HLANDING ROLL/37X,6HISS = F2.0,10X,6HILR = I1,
     C10X,6HICS = I1,10X,6HIBS = I1)
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      CALL STFL(2,2,PRT5)
      CALL STOVAR(2,TI,TR,DU,DU,DU,DU,DU,DU)
      CALL STFL(0,1,DU)
      RETURN
C
C     ENTRY FOR PRINTING PITCH AUTOPILOT DATA
C
      ENTRY AUTPR5
      IF(PITCHP.EQ.0)RETURN
      CALL LINES(1)
      WRITE(6,50)
 50   FORMAT(58X,15HPITCH AUTOPILOT)
      CALL STFL(2,6,PRT6)
      ALPHD1=ALPHR1*57.2957795
      CALL STOVAR(6,DELQN,ALPHAE,ALPHD1,ALPDD1,ALPHET,DELQDE,
     1DU,DU)
      CALL STFL(0,1,DU)
      RETURN
C
C     ENTRY FOR PRINTING YAW AUTOPILOT DATA
C
      ENTRY AUTPR6
      IF(YAWAUP.EQ.0)RETURN
      CALL LINES(1)
      WRITE(6,60)
 60   FORMAT(58X,13HYAW AUTOPILOT)
      CALL STFL(2,7,PRT7)
      BETAD1=BETAR1*57.2957795
      CALL STOVAR(7,DELRN,BETAD,BETAD1,BETAET,DELRDE,
     1PSIE,PSIET,DU)
      CALL STFL(0,1,DU)
      RETURN
C
C     ENTRY FOR PRINTING ROLL AUTOPILOT
C
      ENTRY AUTPR7
      IF(ROLLAP.EQ.0)RETURN
      CALL LINES(1)
      WRITE(6,70)
 70   FORMAT(58X,14HROLL AUTOPILOT)
      CALL STFL(2,3,PRT8)
      CALL STOVAR(3,PHIE,PHIET,DELPDE,DU,DU,DU,DU,DU)
      CALL STFL(0,1,DU)
      RETURN
C
C     ENTRY FOR PRINTING THROTTLE AUTOPILOT
C
      ENTRY AUTPR8
      IF(THROAP.EQ.0)RETURN
      CALL LINES(3)
      WRITE(6,80)
 80   FORMAT(58X,18HTHROTTLE AUTOPILOT)
      WRITE(6,81) (ND(I),I=1,IN)
 81   FORMAT(21X,9HND(IN) = E15.8,4(5X,E15.8))
      WRITE(6,82) (TD(I),I=1,IN)
 82   FORMAT(21X,9HTD(IN) = E15.8,4(5X,E15.8))
      RETURN
C
C     ENTRY FOR PRINTING BRAKE AUTOPILOT
C
      ENTRY AUTPR9
      IF(BRAKAP.EQ.0)RETURN
      CALL LINES(2)
      WRITE(6,90) (MB(I),I=1,NSTRUT)
 90   FORMAT(58X,15HBRAKE AUTOPILOT/21X,9HMB(I)   = E15.8,
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   C4(5X,E15.8))
      IF(IBS.NE.1)RETURN
      CALL LINES(3)
      WRITE(6,91) (OMEGTR(I),I=1,NSTRUT)
 91   FORMAT(17X,13HOMEGATR(I) = E15.8,4(5X,E15.8))
      WRITE(6,92) (OMTR01(I),I=1,NSTRUT)
 92   FORMAT(15X,15HOMEGATR01(I) = E15.8,4(5X,E15.8))
      WRITE(6,93) (OMEGTE(I),I=1,NSTRUT)
 93   FORMAT(17X,13HOMEGATE(I) = E15.6,4(5X,E15.8))
      RETURN
C
C     ENTRY FOR PRINTING CONTROL RESPONSE DATA
C
      ENTRY AUTP10
      IF(CONTRP.EQ.0)GO TO 12
      CALL LINES(1)
      WRITE(6,100)
 100  FORMAT(58X,16HCONTROL RESPONSE)
      CALL STFL(2,6,PRT9)
      CALL STOVAR(6,DELQ01,DELR01,DELP01,DELQD,DELRD,
     1DELPD,DU,DU)
      CALL STFL(2,1,DU)
      CALL LINES(2)
      WRITE(6,101) (N01(I),I=1,IN)
 101  FORMAT(24X,6HN01 = E15.8,4(5X,E15.8))
      WRITE(6,102) (N(I),I=1,IN)
 102  FORMAT(24X,6HN    = E15.8,4(5X,E15.8))
C
C     WRITING OF INDICATORS
C
 12   IF(INDICP.EQ.0)RETURN
      CALL LINES(2)
      WRITE(6,11) IAP,(IC(I),I=1,4),(IC(J),J=1,5)
 11   FORMAT(61X,10HINDICATORS/30X,5HIAP =I2,10X,
     C7HIC(I) =I2,1H,,I2,1H,,I2,1H,,I2,10X,
     C7HIB(I) =I2,1H,,I2,1H,,I2,1H,,I2,1H,,I2)
      RETURN
      END
      SUBROUTINE THAUTS(IPR)
C
C     THROTTLE AUTOPILOT
C
C         INPUT REQUIRED (FROM DIRCOM)
C     TF(I) - FIX ARRAY FOR ENGINE I
C     NDF(I)- THROTTLE SETTING FOR TF(I)
C     IR(I) - REVERSE CAPABILITY ARRAY FOR ENGINE I
C     NB(I) - THROTTLE CONSTRAINT ARRAY FOR REVERSE FOR ENG. I
C     NLR(I)- REVERSE THROTTLE SETTING FOR REVERSE SIGNAL ON LANDING
C     NTO(I)- TAKE OFF THROTTLE SETTING FOR ENGINE I
C     KE(I) - KILL ENGINE OPTION FOR ENG. I FOR HOLD MODE
C       THE FOLLOWING ARE ENGINE LOAD CONSTANTS FOR VARIABLE
C          ENGINE COMBINATIONS
C     K2    - K(2)121
C     K3(I) - K(3)131, K(3)232, K(3)121, K(3)1231, K(3)1232
C     K4(I) - K(4)141, K(4)232, K(4)343, K(4)242, K(4)2342,
C             K(4)2343, K(4)1341, K(4)1343, K(4)12341,
C             K(4)12342, K(4)12343
C     IN    - NUMBER OF ENGINES
C     ILR   - REVERSE SIGNAL INITIALIZATION
C     IAP   - PROBLEM PHASE INDICATOR
C     TTO   - DESIRED THRUST
C
C          INPUT FROM SDF2(DIRCOM)
C     N(I)
C
```

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```
      COMMON/DI3COM/DM1(1585),IN,DM2(11),N(5),DM3(27),IAP,DM8(12),TTD,
     *DM4( 9),KE(5),DM5(6),ILR,DM9,IC(5),DM6(84),
     *TF(5),NDF(5),IR(5),NB(5),
     *NLR(5),NTO(5),K2,K3(5),K4(11),DM7(91),DDM8(2068)
C
C          INPUT FROM AUTS
C     TD(I), TDA, TDB, IC(I), NDA, NDB, NDC
C
C           OUTPUT GENERATED FOR AUTS
C     TD(I), TC, TDX, IRA, IRB, IRC, NA, NC, ND(I), NBA, NBB, NBC,
C     NLRA, NLRB, NLRC, NTOA, NTOB, NTOC, KA, KB, KT, KEA,
C     KEB, ICA, ICB, NNB
C
      COMMON/AUTSC/TR,TC,TDX,
     1TDA,TDB,TD(5),IRA,IRB,IRC,ICA,ICB,
     2KA,KB,KEA,KEB,KT,NA,NNB,NC,ND(5),NBA,NBB,NBC,
     3NLRA,NLRB,NLRC,NDA,NDB,NDC,NTOA,NTOB,NTOC
C
      REAL NDF,NB,N,NNB,NLR,NTO,K2,K3,K4,KA,KB,
     1NA,NC,ND,NBA,NBB,NBC,NLRA,NLRB,NLRC,
     2NTOA,NTOB,NTOC,NDA,NDB,NDC
C
      COMMON/AUTPRC/YR,ZR,YRD1,ZRD1,PSIPD1,PHIPD1,
     1VE,VAD,GAMPPD,QR,CLR,CDR,LR,DR,HGS,RR,HEA,HE,
     2HET,HPA,HPT,PHIDES,TX,TH,XRFD1,YRFD1,AXR,AHR,
     3ALPHAE,ALPUD1,ALPHET,DELRN,BETAET,DELRDE,DM,
     4PHIE,PHIET,DELPDE,DELQD1,DELRD1,DELPD1,
     5NJ1(5),OMEGTR(5),OMTRD1(5),OMEGTE(5),PSIE,PSIET
C
      INTEGER TF
C     CHECK ENGINE NO.
      DO 1 I=1,IN
      ND(I)=0.
    1 TD(I)=0.
      IF(IN-2)10,20,5
    5 IF(IN-4)30,40,40
C
C     SINGLE ENGINE LOGIC
C
   10 IF(TF(1).EQ.1)GO TO 11
      IF(IC(1).EQ.0)GO TO 12
C     SET UP DATA FOR COMMON ENGINE LOGIC
      TD(1)=TTD
      IRC=IR(1)
      NC=N(1)
      NBC=NB(1)
      NLRC=NLR(1)
      NTOC=NTO(1)
      TC=TD(1)
      KT=KE(1)
C     CALL COMMON ENGINE LOGIC
      CALL CENGL
      ND(1)=NDC
      GO TO 200
   11 ND(1)=NDF(1)
      IF(ILR.EQ.1)ND(1)=ENGREV(IR(1),N(1),NB(1),NLR(1))
      IF(IC(1).NE.0)GO TO 200
   12 ND(1)=0.
      GO TO 200
C
C     TWO ENGINE LOGIC
C
   20 IF((TF(1).EQ.1).OR.(TF(2).EQ.1))GO TO 21
      TDX=TTD
      ICA=IC(1)
```

```
      IRA=IR(1)
      NA=N(1)
      NBA=NB(1)
      NLRA=NLR(1)
      NTOA=NTO(1)
      KEA=KE(1)
      KA=K2
      ICB=IC(2)
      IRB=IR(2)
      NNB=N(2)
      NBB=NB(2)
      NLRB=NLR(2)
      NTOB=NTO(2)
      KEB=KE(2)
      KB=1.-K2
C     CALL COMMON TWO ENGINE LOGIC
      CALL CTENGL
      TD(1)=TDA
      TD(2)=TDB
      ND(1)=NDA
      ND(2)=NDB
      GO TO 200
21    ND(1)=NDF(1)
      ND(2)=NDF(2)
      IF(ILR.EQ.1)ND(1)=ENGREV(IR(1),N(1),NB(1),NLR(1))
      IF(ILR.EQ.1)ND(2)=ENGREV(IR(2),N(2),NB(2),NLR(2))
      IF(IC(1).EQ.0)ND(1)=0.
      IF(IC(2).EQ.0)ND(2)=0.
      GO TO 200
C
C     THREE ENGINE LOGIC
C
C     NOTE: ONCE AN ENGINE IS STOPPED, IT STAYS FIXED
C           EXCEPT TO FAIL
C
30    DO 31 I=1,3
      IF(TF(I).NE.1)GO TO 22
31    CONTINUE
      DO 23 I=1,3
      ND(I)=NDF(I)
      IF(ILR.EQ.1)ND(I)=ENGREV(IR(I),N(I),NB(I),NLR(I))
      IF(IC(I).EQ.0)ND(I)=0.
23    CONTINUE
      GO TO 200
22    IF((TF(1).EQ.1).AND.(TF(3).EQ.1))GO TO 24
      IF(TF(2).NE.1)GO TO 50
      ND(2)=NDF(2)
      IF(ILR.EQ.1)ND(2)=ENGREV(IR(2),N(2),NB(2),NLR(2))
      IF(IC(2).EQ.0)ND(2)=0.
      CALL TFFS3(ND(2),TD(2))
26    TDX=TTD-TD(2)
      I1=1
      I2=3
      I3=0
27    ICA=IC(I1)
      ICB=IC(I2)
      IRA=IR(I1)
      IRB=IR(I2)
      NA=N(I1)
      NNB=N(I2)
      NBA=NB(I1)
      NBB=NB(I2)
      NLRA=NLR(I1)
      NLRB=NLR(I2)
      NTOA=NTO(I1)
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       NTOB=NTO(I2)
       KEA=KE(I1)
       KEB=KE(I2)
       I4=I1+I3
       KA=K3(I4)
       K3=1.-K3(I4)
C      CALL COMMON TWO ENGINE LOGIC
       CALL CTENGL
       TD(I1)=TDA
       TD(I2)=TDB
       ND(I1)=NDA
       ND(I2)=NDB
       GO TO 200
 24    ND(1)=NDF(1)
       ND(3)=NDF(3)
       IF(ILR.EQ.1)ND(1)=ENGREV(IR(1),N(1),NB(1),NLR(1))
       IF(ILR.EQ.1)ND(3)=ENGREV(IR(3),N(3),NB(3),NLR(3))
       IF(IC(1).EQ.0)ND(1)=0.
       IF(IC(3).EQ.0)ND(3)=0.
       CALL TFFS9(ND(1),TD(1))
       CALL TFFS9(ND(3),TD(3))
       IF(IC(2).EQ.0)GO TO 51
       TD(2)=TTD-TD(1)-TD(3)
       I1=2
       I3=1
 28    IRC=IR(I1)
       NC=N(I1)
       NBC=NB(I1)
       NLRC=NLR(I1)
       NTOC=NTO(I1)
       TC=TD(I1)
       KT=KE(I1)
C      CALL COMMON ENGINE LOGIC
       CALL CENGL
       ND(I1)=NDC
       GO TO (29,56,57,29),I3
 29    GO TO 200
 51    ND(2)=0.
       GO TO 200
 50    IF(IC(1).EQ.0)GO TO 60
       IF(IC(2).NE.0)GO TO 55
       ND(2)=0.
       CALL TFFS9(ND(2),TD(2))
       GO TO 26
 60    ND(1)=0.
       CALL TFFS9(ND(1),TD(1))
       TDX=TTD-TD(1)
       I1=2
       I2=3
       I3=0
       GO TO 27
 55    IF(IC(3).EQ.0)GO TO 58
       TD(1)=TTD*K3(4)
       I1=1
       I3=2
       GO TO 28
 56    TD(2)=TTD*K3(5)
       I1=2
       I3=3
       GO TO 28
 57    TD(3)=TTD-TD(1)-TD(2)
       I1=3
       I3=4
       GO TO 28
 58    ND(3)=0.
```

```
      CALL TFFS9(ND(3),TD(3))
      I1=1
      I2=2
      I3=2
      GO TO 27
C
C     FOUR ENGINE LOGIC
C
40    DO 41 I=1,4
      IF(TF(I).NE.1)GO TO 42
41    CONTINUE
      DO 43 I=1,4
      ND(I)=NDF(I)
      IF(ILR.EQ.1)ND(I)=ENGREV(IR(I),N(I),NB(I),NLR(I))
      IF(IC(I).EQ.0)ND(I)=0.
43    CONTINUE
      GO TO 2[illegible]
42    IF((TF(2).EQ.1).AND.(TF(3).EQ.1))GO TO 70
      IF((TF(1).NE.1).OR.(TF(4).NE.1))GO TO 80
      ND(1)=NDF(1)
      ND(4)=NDF(4)
      IF(ILR.EQ.1)ND(1)=ENGREV(IR(1),N(1),NB(1),NLR(1))
      IF(ILR.EQ.1)ND(4)=ENGREV(IR(4),N(4),NB(4),NLR(4))
      IF(IC(1).EQ.0)ND(1)=0.
      IF(IC(4).EQ.0)ND(4)=0.
      CALL TFFS9(ND(1),TD(1))
      CALL TFFS9(ND(4),TD(4))
      TDX=TTD-TD(1)-TD(4)
      I1=2
      I2=3
44    ICA=IC(I1)
      ICB=IC(I2)
      IRA=IR(I1)
      IRB=IR(I2)
      NA=N(I1)
      NNB=N(I2)
      NBA=NB(I1)
      NBB=NB(I2)
      NLRA=NLR(I1)
      NLRB=NLR(I2)
      NTOA=NTO(I1)
      NTOB=NTO(I2)
      KEA=KE(I1)
      KEB=KE(I2)
      KA=K4(I1)
      KB=1.-K4(I1)
      CALL CTENGL
      TD(I1)=TDA
      TD(I2)=TDB
      ND(I1)=NDA
      ND(I2)=NDB
      GO TO 2[illegible]
70    ND(2)=NDF(2)
      ND(3)=NDF(3)
      IF(ILR.EQ.1)ND(2)=ENGREV(IR(2),N(2),NB(2),NLR(2))
      IF(ILR.EQ.1)ND(3)=ENGREV(IR(3),N(3),NB(3),NLR(3))
      IF(IC(2).EQ.0)ND(2)=0.
      IF(IC(3).EQ.0)ND(3)=0.
      CALL TFFS9(ND(2),TD(2))
      CALL TFFS9(ND(3),TD(3))
      TDX=TTD-TD(2)-TD(3)
      I1=1
      I2=4
      GO TO 44
      DO 81 I=1,4
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      IF(IC(I).NE.0)GO TO 93
 81   CONTINUE
      GO TO 95
 90   DO 82 I=1,3
      IF(IC(I).NE.0)GO TO 91
 82   CONTINUE
      GO TO 97
 91   IF((IC(1).NE.0).OR.(IC(2).NE.0))GO TO 100
      IF(IC(4).NE.0)GO TO 100
      ND(1)=0.
      ND(2)=0.
      ND(4)=0.
      CALL TFF33(0.,TD(1))
      TD(2)=TD(1)
      TD(4)=TD(1)
      TD(3)=TTD-TD(1)-TD(2)-TD(4)
      I1=3
      I2=1
 83   IRC=IR(I1)
      NC=N(I1)
      NBC=NB(I1)
      NLRC=NLR(I1)
      NTOC=NTO(I1)
      TC=TD(I1)
      KT=KE(I1)
      CALL CENGL
      ND(I1)=NDC
      GO TO (84,101,102,103,111,121,131,141,151,152,161,162),I2
 84   GO TO 200
 95   DO 96 I=1,4
 96   ND(I)=0.
      GO TO 200
 97   DO 98 I=1,3
 98   ND(I)=0.
      CALL TFF33(0.,TD(1))
      TD(2)=TD(1)
      TD(3)=TD(1)
      TD(4)=TTD-TD(1)-TD(2)-TD(3)
      I1=4
      I2=1
      GO TO 83
 100  IF((IC(1).EQ.0).AND.(IC(2).EQ.0))GO TO 110
      IF((IC(1).EQ.0).AND.(IC(3).EQ.0))GO TO 120
      IF((IC(1).EQ.0).AND.(IC(4).EQ.0))GO TO 130
      IF((IC(2).EQ.0).AND.(IC(3).EQ.0))GO TO 140
      IF(IC(1).EQ.0)GO TO 150
      IF(IC(2).EQ.0)GO TO 160
      I1=1
      I2=2
      TD(1)=TTD*K4(9)
      GO TO 83
 101  TD(2)=TTD*K4(10)
      I1=2
      I2=3
      GO TO 83
 102  TD(3)=TTD*K4(11)
      I1=3
      I2=4
      GO TO 83
 103  TD(4)=TTD-TD(1)-TD(2)-TD(3)
      I1=4
      I2=1
      GO TO 83
 110  ND(1)=0.
      ND(2)=0.
```

```
      CALL TFFS9(0.,TD(1))
      TD(2)=TD(1)
      TD(3)=(TTD-TD(1)-TD(2))*K4(3)
      I1=3
      I2=9
      GO TO 83
111   TD(4)=(TTD-TD(1)-TD(2))*(1.-K4(3))
      I1=4
      I2=1
      GO TO 83
120   ND(1)=0.
      ND(3)=0.
      CALL TFFS9(0.,TD(1))
      TD(3)=TD(1)
      TD(2)=(TTD-TD(1)-TD(3))*K4(4)
      I1=2
      I2=6
      GO TO 83
121   TD(4)=(TTD-TD(1)-TD(3))*(1.-K4(4))
      I1=4
      I2=1
      GO TO 83
130   ND(1)=0.
      ND(4)=0.
      CALL TFFS9(0.,TD(1))
      TD(4)=TD(1)
      TD(2)=(TTD-TD(1)-TD(4))*K4(2)
      I1=2
      I2=7
      GO TO 83
131   TD(3)=(TTD-TD(1)-TD(4))*(1.-K4(2))
      I1=3
      I2=1
      GO TO 83
140   ND(2)=0.
      ND(3)=0.
      CALL TFFS9(0.,TD(2))
      TD(3)=TD(2)
      TD(1)=(TTD-TD(2)-TD(3))*K4(1)
      I1=1
      I2=8
      GO TO 83
141   TD(4)=(TTD-TD(2)-TD(3))*(1.-K4(1))
      I1=4
      I2=1
      GO TO 83
150   ND(1)=0.
      CALL TFFS9(0.,TD(1))
      TD(2)=(TTD-TD(1))*K4(5)
      I1=2
      I2=9
      GO TO 83
151   TD(3)=(TTD-TD(1))*K4(6)
      I1=3
      I2=10
      GO TO 83
152   TD(4)=(TTD-TD(1))*(1.-K4(5)-K4(6))
      I1=4
      I2=1
      GO TO 83
160   ND(2)=0.
      CALL TFFS9(0.,TD(2))
      TD(1)=(TTD-TD(2))*K4(7)
      I1=1
      I2=11
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      GO TO 83
161   TD(3)=(TTD-TD(2))*K4(8)
      I1=3
      I2=12
      GO TO 83
162   TD(4)=(TTD-TD(2))*(1.-K4(7)-K4(8))
      I1=4
      I2=1
      GO TO 83
200   IF(IPR.EQ.1)CALL AUTPR8
      RETURN
      END
      FUNCTION ENGREV(IRC,NC,NBC,NLRC)
      REAL NC,NBC,NLRC
      IF(IRC.EQ.1)GO TO 1
2     ENGREV=1.
      RETURN
1     IF(NC.GT.NBC)GO TO 2
      ENGREV=NLRC
      RETURN
      END
      SUBROUTINE ENGFL
C
C         INPUT REQUIRED (FROM DIRCOM)
C     XRF1   - FIRST RUNWAY POSITION TO STAGE ENGINE FAILURE
C     IT1(I)- ARRAY ASSOCIATED WITH XRF1
C     XRF2   - SECOND RUNWAY POSITION TO STAGE ENGINE FAILURE
C     IT2(I)- ARRAY ASSOCIATED WITH XRF2
C     H1     - FIRST ALT. TO STAGE ENGINE FAILURE IN GLIDE SLOPE
C     IH1(I)- ARRAY ASSOCIATED WITH H1
C     H2     - SECOND ALT. TO STAGE ENGINE FAILURE IN GLIDE SLOPE
C     IH2(I)- ARRAY ASSOCIATED WITH H2
C     HR1    - FIRST ALT. TO STAGE ENGINE FAILURE IN FLARE
C     IHR1(I) ARRAY ASSOCIATED WITH HR1
C     HR2    - SECOND ALT. TO STAGE ENGINE FAILURE IN FLARE
C     IHR2(I) ARRAY ASSOCIATED WITH HR2
C     TR1    - FIRST TIME AFTER IMPACT TO STAGE ENGINE FAILURE
C     ITR1(I) ARRAY ASSOCIATED WITH TR1
C     TR2    - SECOND TIME AFTER IMPACT TO STAGE ENGINE FAILURE
C     ITR2(I) ARRAY ASSOCIATED WITH TR2
C     IAP    - PROBLEM PHASE INDICATOR
C
C          INPUT FROM SOF(DIRCOM)
C     HGC7F
C
      COMMON/DIRCOM/DM1(434),HGC7F,DM2(1193),IAP,DM3(35),
     *IC(5),XRF1,IT1(5),XRF2,IT2(5),H1,IH1(5),H2,IH2(5),
     *HR1,IHR1(5),HR2,IHR2(5),TR1,ITR1(5),TR2,ITR2(5),DM4(109),HR,
     *DM5(16),XR,DM6(47),DM7(2068)
C
C          INPUT FROM AUTS
C     XR, TR
C
C          OUTPUT GENERATED
C     IC(I) - INITIALIZATION OF FAILURE INDICATOR OF ENGINE I
C
      COMMON/AUTSC/TR,TC,TOX,
     1TDA,TDB,TD(5),IRA,IRB,IRC,ICA,IDB,
     2KA,KB,KEA,KED,KT,NA,NNB,NC,ND(5),NBA,NBB,NBC,
     3NLRA,NLRB,NLRC,NDA,NDB,NDC,NTOA,NTOB,NTOC
C
C     ENGINE FAILURE LOGIC
C         (ONCE AN ENGINE FAILS-MUST REMAIN FAILED)
      IF(IAP-2)10,20,30
10    IF(HGC7F.GT.H1)GO TO 11
```

```
      DO 12 I=1,4
12    IC(I)=IH1(I)
11    IF(HGC7F.GT.H2)RETURN
      DO 13 I=1,4
13    IC(I)=IH2(I)
      RETURN
20    IF(HR.GT.HR1)GO TO 21
      DO 22 I=1,4
22    IC(I)=IHR1(I)
21    IF(HR.GT.HR2)RETURN
      DO 23 I=1,4
23    IC(I)=IHR2(I)
      RETURN
30    IF(IAP-4)20,40,50
40    IF(TR.LT.TR1)GO TO 41
      DO 42 I=1,4
42    IC(I)=ITR1(I)
41    IF(TR.LT.TR2)RETURN
      DO 43 I=1,4
43    IC(I)=ITR2(I)
      RETURN
50    IF(XR.LT.XRF1)GO TO 51
      DO 52 I=1,4
52    IC(I)=IT1(I)
51    IF(XR.LT.XRF2)RETURN
      DO 53 I=1,4
53    IC(I)=IT2(I)
      RETURN
      END
      SUBROUTINE CENGL
C
C     COMMON ENGINE LOGIC
C
C           INPUT FROM DIRCOM
C     ILR, IAP
C
      COMMON/DIRCOM/DM1(1628),IAP,DM2(33),ILR,DM3(228),DM4(2068)
C
C           INPUT FROM AUTS
C     TC, IRC, NC, NBC, KT, NTOC, NLRC
C
C           OUTPUT GENERATED FOR AUTS
C     NOC
C
      COMMON/AUTSC/TR,TC,TOX,
     1TOA,TOB,TO(5),IRA,IRB,IRC,ICA,ICB,
     2KA,KB,KEA,KEB,KT,NA,NNE,NC,ND(5),NBA,NBB,NBC,
     3NLRA,NLRB,NLRC,NOA,NOB,NOC,NTOA,NTOB,NTOC
C
      REAL N,NC,NBC,NLRC,NTOC,NOC
      IF(ILR.EQ.1)GO TO 10
      IF(IAP-3)11,12,13
11    CALL TFFS8(TC,N)
      IF(N.GT.0.)GO TO 20
      IF(IRC.NE.1)GO TO 21
      IF(NC.GT.NBC)GO TO 21
20    NOC=N
      RETURN
21    NOC=1.
      RETURN
12    IF(KT.NE.1)GO TO 11
      GO TO 21
13    IF(IAP.LT.5)GO TO 12
      NOC=NTOC
      RETURN
```

```
      IF(IRC.NE.1)GO TO 21
      IF(NC.GT.NBC)GO TO 21
      NDC=NLRC
      RETURN
      END
      SUBROUTINE CTENGL
C
C     COMMON TWO ENGINE LOGIC
C
C          INPUT FFOM AUTS
C     ICA, ICB, IRB, NNB, NOB, NLRB, NTOB, TOB, KEB, NDC, TDX,
C     IRA, NA, NBA, NLRA, NTOA, TDA, KEA, KA, KB
C     TOB
C          OUTPUT GENERATLD FOR AUTS
C     NDA, NDB, IRC, NC, NBC, NLRC, NTOC, TC, KT, NDB
C     TDA, TDB
C
      COMMON/AUTSC/TR,TC,TDX,
     1TD  ,TDB,TD(5),IRA,IRB,IRC,ICA,ICB,
     2KA,KB,KEA,KEB,KT,NA,NNB,NC,ND(5),NBA,NBB,NBC,
     3NLRA,NLRB,NLRC,NDA,NDB,NDC,NTOA,NTOB,NTOC
C
      REAL KA,KB,NA,NNB,NC,NBA,NBB,NBC,NDA,NDB,NDC,NLRA,
     1NLRB,NLRC,NTOA,NTOB,NTOC
      IF((ICA.EQ.0).AND.(ICB.EQ.0))GO TO 30
      IF(ICA.EQ.0)GO TO 20
      IF(ICB.EQ.0)GO TO 10
      TDA=KA*TDX
      IRC=IRA
      NC=NA
      NBC=NBA
      NLRC=NLRA
      NTOC=NTOA
      TC=TDA
      KT=KEA
      CALL CENGL
      NDA=NDC
      TDB=KB*TDX
    5 IRC=IRB
      NC=NNB
      NBC=NBB
      NLRC=NLRB
      NTOC=NTOB
      TC=TDB
      KT=KEB
      CALL CENGL
      NDB=NDC
      RETURN
   10 NDB=0.
      CALL TFFS9(0.,TDB)
      TDA=TDX-TDB
      IRC=IRA
      NC=NA
      NBC=NBA
      NLRC=NLRA
      NTOC=NTOA
      TC=TDA
      KT=KEA
      CALL CENGL
      NDA=NDC
      RETURN
   20 NDA=0.
      CALL TFFS9(0.,TDA)
      TDB=TDX-TDA
      GO TO 5
   30 NDA=0.
      NDB=0.
      RETURN
      END
```

APPENDIX B

DERIVATION OF AERODYNAMIC WEIGHTING FACTORS

AERODYNAMIC WEIGHTING FACTORS

In the TOLA computer program, the aerodynamic effects are treated as concentrated loads in the form of total aerodynamic forces and moments acting at a reference point on the airframe. These quantities are calculated in the aerodynamics subprogram (SACS) and are defined as follows:

a – axial force (body axis)

y – side force (body axis)

n_f – normal force (body axis)

ℓ – moment about body X axis

m – moment about body Y axis

n – moment about body Z axis

To obtain realistic flexible body response to these aerodynamic loads, weighting effects or participation factors, PF(I), for the response of each normal mode are required.

An approach to determine the weighting effect for the Z translational degree of freedom is given below. A similar method can be used to determine the remaining participation factors.

In TOLA, the generalized aerodynamic force is calculated as the product of the total lift, the vertical modal deflection at the reference point, and a participation factor

$$Q_{A_Z} = n_f \, \phi_{Z_R} \, PF$$

If the actual generalized force due to aerodynamics is obtained by integrating the product of the pressure distribution and modal deflection over the lifting area, the expression for this quantity would be given as

$$Q_{A_Z} = \int_A \phi_Z \, (x,y) \, P(x,y) \, dA$$

Equating the two force expressions, an equation for the participation factor can be obtained.

$$PF = \frac{\int_A \phi_Z \, (x,y) \, P(x,y) \, dA}{n_f \, \phi_{Z_R}}$$

APPENDIX C

PROGRAM LISTING, PLTDAT COMPUTER PROGRAM

```
      PROGRAM PLTDAT(INPUT,TAPE3,TAPE10,OUTPUT,TAPE4)
      DIMENSION TITLE(15),BUF(400),NDIL(28),TBUF(400),
     *AVAL(4,6),
     *BMM(2,400),CMMDS(5),DEPVAR(5),LINE(7),NDVA(5)
      DATA CMMDS/4HPLOT,6HTITLE1,6HTITLE2,6HINDVAR,6HDEPVAR/
      DATA NPUT/5LINPUT/
      READ(NPUT,105)NPTS
105   FORMAT(I6)
      READ(3) NHL
      NW=0
      NDL=0
      NHL=NHL-1
      DO 10 N=1,NHL
      READ(3) NI,ND,(TITLE(I),I=1,NI)
106   FORMAT(2I6,3A6)
      IF (ND.GT.1) GO TO 7
      NS=NW+1
      NDL=NDL+1
      NDIL(NDL)=NI
100   FORMAT(13A10)
      ENCODE(130,100,TBUF(NS))(TITLE(I),I=1,NI)
      NW=NW+NI
      GO TO 10
7     DO 8 J=1,ND
      NS=NW+1
      NDL=NDL+1
      NDIL(NDL)=NI
      IF(J.LE.9)GO TO 111
      ENCODE(130,110,TBUF(NS))(J,TITLE(I),I=1,NI)
110   FORMAT(13(I2,A8))
      GO TO 112
111   ENCODE(130,113,TBUF(NS))(J,TITLE(I),I=1,NI)
113   FORMAT(13(*0*,I1,A8))
112   NW=NW+NI
8     CONTINUE
10    CONTINUE
      READ(3) IX
      DO 15 I=1,NW
      BMM(1,I)=1.E60
15    BMM(2,I)=-1.E60
      K=0
30    NDI=0
      DO 35 N=1,NDL
      NIL=NDIL(N)
      READ(3) (BUF(I+NDI),I=1,NIL)
      IF(EOF,3) 50,35
35    NDI=NDI+NIL
      READ(3) ENDPNT
      WRITE(4) (BUF(I),I=1,NW)
      DO 36 I=1,NW
      BMM(1,I)=AMIN1(BMM(1,I),BUF(I))
36    BMM(2,I)=AMAX1(BMM(2,I),BUF(I))
      K=K+1
      IF(K.GT.NPTS) GO TO 50
      GO TO 30
50    DO 51 I=1,15
51    TITLE(I)=10H
      NIV=0
      NDV=0
      KT1=0
      KT2=0
      CALL PLOTS(DUM,DUM,10)
      CALL PLOT(0.,1.,-3)
60    READ(NPUT,900)CMMD,LINE
900   FORMAT(10A10)
```

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```
      IF(EOF,NPUT) 9.,59
59    DO 61 K=1,5
      IF(CMMD.EQ.CMMDS(K)) GO TO (80,62,63,65,66),K
61    CONTINUE
      PRINT 300,CMMD
300   FORMAT(* IMPROPER COMMAND-*,A10)
      STOP
62    ENCODE(40,100,TITLE(1))(LINE(I),I=1,4)
      KT1=KTB(TITLE(1),40)
      GO TO 60
63    ENCODE(40,100,TITLE(5))(LINE(I),I=1,4)
      KT2=KTB(TITLE(5),40)
      GO TO 60
65    CALL FIND(TBUF,NH,LINE(1),NIV)
      IF(NIV.NE.0) GO TO 70
      PRINT 310,LINE(1)
310   FORMAT(* IMPROPER INDEPENDENT VARIABLE-*,A10)
      STOP
70    AVAL(1,1)=BMM(1,NIV)
      AVAL(2,1)=BMM(2,NIV)
      GO TO 60
66    NDV=0
      DO 69 N=1,5
      IF(LINE(N).EQ.1H ) GO TO 67
      CALL FIND(TBUF,NH,LINE(N),NDVA(N))
      IF(NDVA(N).NE.0) GO TO 68
      PRINT 320,LINE(N)
320   FORMAT(* IMPROPER DEPENDENT VARIABLE *,A10)
      STOP
67    NDV=N-1
      GO TO 60
68    NDX=NDVA(N)
      AVAL(1,N+1)=BMM(1,NDX)
      AVAL(2,N+1)=BMM(2,NDX)
      CALL SCALE(AVAL(1,N+1),6.,2,1)
69    CONTINUE
      NDV=5
      GO TO 60
80    IF(NIV.NE.0) GO TO 81
      PRINT 330
330   FORMAT(* NO INDEPENDENT VARIABLE*)
      STOP
81    IF(NDV.NE.0) GO TO 82
      PRINT 340
340   FORMAT(* NO DEPENDENT VARIABLES*)
      STOP
82    IF(KT1.NE.0) CALL LABEL(1.,6.5,10.,6.5,TITLE(1),KT1,
     *.3,2,0.,0.,0)
      IF(KT2.NE.0) CALL LABEL(1.,6.1,10.,6.1,TITLE(5),KT2,
     *.2,2,0.,0.,0)
      CALL PLOT(NDV*.6+.5,0.,-3)
      AXLEN=10.-NDV*.6
      CALL SCALE(AVAL(1,1),AXLEN,2,1)
      CALL AXIS(0.,0.,TBUF(NIV),-10,AXLEN,0.,AVAL(3,1),AVAL(4,1))
      DO 89 J=1,NDV
      JD=NDVA(J)
      REWIND 4
      IP=3
83    READ(4) (BUF(I),I=1,NH)
      IF(EOF,4) 85,84
84    VARIND=(BUF(NIV)-AVAL(3,1))/AVAL(4,1)
      VARDEP=(BUF(JD)-AVAL(3,J+1))/AVAL(4,J+1)
      IF(IP.EQ.3) CALL SYMBOL(VARIND,VARDEP,.1,J,0.,-1)
      IF(IP.NE.3) CALL PLOT(VARIND,VARDEP,2)
      IP=2
```

```
      GO TO 83
 85   NSUB=NOVA(J)
      CALL AXIS(-(J-1)*.6,0.,TBUF(NSUB),10,6.,90.,AVAL(3,J+1),
     *AVAL(4,J+1))
      CALL SYMBOL(-(J-1)*.6-.4,1.,.14,J,90.,-1)
 89   CONTINUE
      CALL PLOT(AXLEN+1.,0.,-3)
      GO TO 60
 90   CALL PLOT(0.,0.,999)
      STOP
      END
      FUNCTION KTB(ISTRG,IST)
      DIMENSION ISTRG(1)
      DO 20 I=1,IST
      KTB=IST+1-I
      NHD=(KTB+9)/10
      NBITS=6*MOD(KTB,10)
      ITST=ISHIFT(ISTRG(NHD),NBITS).AND.77B
      IF(ITST.NE.55B) RETURN
 20   CONTINUE
      KTB=0
      RETURN
      END
      SUBROUTINE FIND(TBUF,NW,COMP,N)
      DIMENSION TBUF(1)
      DO 10 N=1,NW
      IF(TBUF(N).EQ.COMP) RETURN
 10   CONTINUE
      N=0
      RETURN
      END
```

APPENDIX D

AIRPLANE A RIGID BODY EXAMPLE 1

```
0010.STCASE  TAB
0011.ATAB01       2
0012.ATAB02       2
0013.ATAB10       2
0014.ATAB11       2
0015.ATAB12       2
0016.ATAB15       2
0017.ATAB16       2
0018.ATAB27       2
0019.ATAB28       2
0020.ATAB43       2
0021.ATAB44       2
0022.ATAB48       2
0023.ATAB51       2
0024.ATAB52       2
0025.ATAB53       2
0026.ATAB56       2
0027.ATAB57       2
0028.ATAB61       2
0029.ATAB63       2
0030.ATAB68       2
0031.ATAB69       2
0032.ATAB70       2
0033.ATAB71       2
0034.ATAB77       2
0035.ATAB80       2
0036.TTAB10       49
0037.VTAB01       5
0038.VTAB02       5
0039.VTAB03       5
0040.VTAB04       5
0041.VTAB06       5
0042.FTAB02       5
0043.FTAB03       50
0044.CTAB01       20
0045.CTAB02       20
0046.CTAB03       20
0047.CTAB04       20
0048.        TRA
0049.STCASE
0050.REM     BCD 3SDF2-GEAR-MOD
0051.NCASE   BCD 1G-MOD
0052.REM     BCD +INTERGATION INFORMATION
0053.IVARBH       0
0054.TMAX         100.
0055.AMINER       .00005
0056.PRTMIN       .04
0057.AMAXER       .1
0058.DELTS        .1
0059.PRINT        .4
0060.REM     BCD 3REQ*D FOR SDF-2
0061.AMASS        19762.852
0062.HG07F        120.824
0063.THTBD        3.5896
0064.GAM7D        -3.
0065.V077F        220.
0066.RH40R        0.
0067.INJAPC       1
0068.INJADD       1
0069.INJFPA       1
0070.INJPLA       1
0071.INJACM       2
0072.INJGRT       1
0073.INJWGT       1
0074.REM     BCD 5VEHICLE PHYSICAL PROP. DATA
```

```
0075.INJVBC          1.
0076.XCGRF           0.
0077.VTAB01          2,0.,1.67,20000.,1.67
0078.VTAB02          2,0.,31.8E+06,20000.,31.8E+06
0079.VTAB03          2,0.,29.4E+06,20000.,29.4E+06
0080.VTAB04          2,0.,57.0E+03,20000.,57.0E+06
0081.INJXZS          1
0082.VTAB06          2,0.,2.39E+06,20000.,2.39E+06
0083.REM        BCD  4AERODYNAMIC INPUT DATA
0084.INJAER          1
0085.AREFF           5200.
0086.D1REFF          30.9
0087.D2REFF          219.
0088.INJA01          1
0089.ATAB01          .0065,.0748
0090.INJA02          1
0091.ATAB02          .437E-3,.542E-3
0092.INJA10          1
0093.ATAB10          1.34,1.12
0094.INJA11          1
0095.ATAB11          .1112,.1038
0096.INJA12          1
0097.ATAB12          -.224E-2,-.1263E-2
0098.INJA15          1
0099.ATAB15          -.00740,-.00819
0100.INJA16          1
0101.ATAB16          .000140,.000158
0102.INJA27          1
0103.ATAB27          -.0236,-.0236
0104.INJA28          1
0105.ATAB28          .267E-3,.267E-3
0106.INJA43          1
0107.ATAB43          .230E-3,.230E-3
0108.INJA44          1
0109.ATAB44          .212E-4,.212E-4
0110.INJA48          1
0111.ATAB48          -.45,-.45
0112.INJA51          1
0113.ATAB51          .0439,.2439
0114.INJA52          1
0115.ATAB52          -.0312,-.0241
0116.INJA53          1
0117.ATAB53          .630E-3,.293E-3
0118.INJA56          1
0119.ATAB56          .0315,.0346
0120.INJA57          1
0121.ATAB57          -.66E-3,-.667E-3
0122.INJA61          1
0123.ATAB61          -8.,-8.
0124.INJA63          1
0125.ATAB63          -24.,-24.
0126.INJA68          1
0127.ATAB68          .182E-2,.182E-2
0128.INJA69          1
0129.ATAB69          .101E-3,.101E-3
0130.INJA70          1
0131.ATAB70          .158E-2,.158E-2
0132.INJA71          1
0133.ATAB71          -.346E-5,-.346E-5
0134.INJA77          1
0135.ATAB77          -.323,-.323
0136.INJA80          1
0137.ATAB80          .139,.155
0138.REM        BCD  3ENGINE THRUST DATA
0139.INJTFF          3
```

```
[ 40.IOUTSO     1
0141.ITIOW      9
0142.ITIOX      4
0143.TTAB10     -2.,-1.5,-1.,-.5,0.,.5,1.,1.5,2.
0144.TTAB10     0.,.1,.2,.3                                             10
0145.TTAB10     -1300.,-690.,-800.,-400.,0.                             14
0146.TTAB10     1100.,2200.,1980.,3740.                                 19
0147.TTAB10     -2050.,-1195.,-340.,-2190.,-900.                        23
0148.TTAB10     2000.,1300.,1795.,3400.                                 28
0149.TTAB10     -3050.,-1500.,-750.,-460.,-1700.                        32
0150.TTAB10     -600.,500.,1605.,3100.                                  37
0151.TTAB10     -4300.,-2865.,-1430.,-845.,-2600.                       41
0152.TTAB10     -1500.,-400.,1400.,2840.                                46
0153.REM    BOO LANDING GEAR DATA
0154.NSTRUT     5
0155.MASS       46.02149,132.0942,132.0942,132.0942
0156.MASS       132.0942                                                5
0157.RX         62.34333,-1.042,-1.042,-19.75333,-19.75333
0158.RY         0.,-12.9375,12.9375,-12.9375,12.9375
0159.RZ         0.,0.,0.,0.,0.
0160.THETAD     0.,0.,0.,0.,0.
0161.ERJEG      0.
0162.RGR        1927.
0163.NTIRES     4.,6.,6.,6.,6.
0164.RZERO      2.011666,2.011666,2.011666,2.011666
0165.RZERO      2.011666                                                5
0166.W          1.41666,1.41666,1.41666,1.41666,1.41666
0167.DELTAM     .83333,.83333,.83333,.83333,.83333
0168.RLT        0.05
0169.IFD        1
0170.AI         129472.2,141992.9,141992.9,141992.9
0171.AI         141992.9                                                5
0172.BI         1.32,1.293,1.293,1.293,1.293
0173.FTAB02     2,0.,0.,1.25,0.
0174.FTAB03     14,0.,0.,.01,.2,.025,.3,.035,.4
0175.FTAB03     .025,.5,.09,.6,.15,.75,.2,.8,.24,.76                    10
0176.FTAB03     .325,.65,.5,.6,.7,.55,1.0,.53,100.,.53                  20
0177.MOMENT     10.5,15.0,15.0,15.8,15.0
0178.MB         0.,0.,0.,0.,0.
0179.RF         16.13660,18.55416,18.55416,18.55416
0180.RF         18.55416                                                5
0181.VZ         0.
0182.PZERO      30470.4,41538.24,41538.24
0183.PZERO      41538.24,41538.24                                       4
0184.VZERO      .5579001,1.162662,1.162662
0185.VZERO      1.162662,1.162662                                       4
0186.A          .492222,.722222,.722222
0187.A          .722222,.722222                                         4
0188.P20        375040.,346154.4,346154.4
0189.P20        346154.4,346154.4                                       4
0190.V20        .6060243,1.1179398,1.1179398
0191.V20        1.1179398,1.1179398                                     4
0192.A2         .394444,.5118055,.5118055
0193.A2         .5118055,.5118055                                       4
0194.IL         0
0195.S2T        .90625,.784166,.784166
0196.S2T        .784166,.784166                                         4
0197.ES2        .020833,.020833,.020833
0198.ES2        .020833,.020833                                         4
0199.C2L        240.,240.,240.,240.,240.
0200.INDG01     1
0201.NSMAIN     2
0202.CTAB01     -1.E6,1.E6
0203.CTAB01     1.,2.,3.,4.,5.                                          3
0204.CTAB01     3024.,3024.,2160.,2160.,2160.,2160.                     8
```

```
0205.CTAB02      2160.,2160.,2160.,2160.                                    14
0206.INDC02      1
0207.CTAB02      -1.E6,1.E6
0208.CTAB02      1.,2.,3.,4.,5.                                              3
0209.CTAB02      3024.,3024.,2160.,2160.,2160.,2160.                          8
0210.CTAB02      2160.,2160.,2160.,2160.                                     14
0211.INDC03      1
0212.NS2NDY      2
0213.CTAB03      -1.E6,1.E6
0214.CTAB03      1.,2.,3.,4.,5.                                              3
0215.CTAB03      72.,72.,72.,72.,72.,72.,72.,72.,72.,72.                      8
0216.INDC04      1
0217.CTAB04      -1.E6,1.E6
0218.CTAB04      1.,2.,3.,4.,5.                                              3
0219.CTAB04      720.,720.,720.,720.,720.,720.                                8
0220.CTAB04      720.,720.,720.,720.                                         14
0221.MASS2       3.1080.99,3.1080.99,3.1080.99
0222.MASS2       3.1080.99,3.1080.99                                          4
0223.MUS         0.,0.,0.,0.
0224.ES          .020833,.020833,.020833
0225.ES          .020833,.020833                                              4
0226.SB          1.08333,2.08333,2.08333
0227.SB          2.08333,2.08333                                              4
0228.REM    BCD 4FLEXIBLE AIRFRAME DATA
0229.INDFLX      0
0250.REM    BCD 3AUTOPILOT DATA
0251.REM    BCD 3A. ENGINE DATA
0252.INDAUT      1
0253.IN          4
0254.ZN          5.41,3.39,3.39,5.41
0255.YN          61.8,39.7,-39.7,-61.8
0256.N           1.975,-1.,-1.,1.975
0257.REM    BCD 3B. DRAG CHUTE DATA
0258.ICS         0
0259.CDCH        0.
0260.SCH         0.
0261.XCH         0.
0262.YCH         0.
0263.ZCH         0.
0264.REM    BCD 5C. PHASE BEGIN-TERMINATE DATA
0265.ITD         0
0266.HF          100.
0267.NF          0
0268.XRF         100.
0269.HRF         25.
0270.DELTAH      3.
0271.KP          0
0272.TI          0.
0273.NCRI        0
0274.VS          10.
0275.KS          10000.
0276.TS          400.
0277.HS          0.
0278.REM    BCD 4D. TAKEOFF COND. DATA
0279.VATO        0.
0280.ALPHTO      0.
0281.REM    BCD 5E. GLIDE SLOPE MANEUVER DATA
0282.VD          220.
0283.DELVE       0.
0284.EPSGS       3.
0285.ALPHGS      -5.
0286.ALPHGL      14.
0287.HCG         20.56
0288.DELEPS      .05
0289.RFH         5.
```

```
F 9J.PGS              .04
..91.DELSIG           .1
.292.RFY              1..
.293.PHIG             1..
.294.REM        BCD  4F. FLARE MANEUVER DATA
.295.XTD              1...
.296.HTD              25.
.297.VXTD             2...
.298.VHTD             -1.
.299.IIR              .
.3...LD               5....
.3.1.DA               .02
.3.2.TL               5....
.3.3.TU               12....
.3.4.REM        BCD  4G. HOLD MANEUVER DATA
.3.5.ALPDES           0.5896
.3.6.TTD              47.76.
.3.7.KE         INT  1,1,1,1
.3.8.PM               1.
.3.9.REM        BCD  5H. LANDING ROLL MANEUVER DATA
.31..TSP              1.
.311.TRV              5.
.312.TCH              ..
.313.TBK              2.
.314.ISS              ..
.315.ILR              .
.316.IBS              .
.317.REM        BCD  5I. ENGINE FAILURE STAGE DATA
.318.IG         INT  1,1,1,1
.319.XRF1             ..
.32..IT1        INT  1,1,1,1
.321.XRF2             ..
.322.IT2        INT  1,1,1,1
.323.H1               ..
.324.IH1        INT  1,1,1,1
.325.H2               ..
.326.IH2        INT  1,1,1,1
.327.HR1              ..
.328.IHR1       INT  1,1,1,1
.329.HR2              ..
.33..IHR2       INT  1,1,1,1
.331.TR1              ..
.332.ITR1       INT  1,1,1,1
.333.TR2              ..
.334.ITR2       INT  1,1,1,1
.335.REM        BCD  5J. BRAKE COND. STAGE DATA
.336.IB         INT  .,1,1,.,1
.337.TBK1             1...
.338.IBK1       INT  .,1,1,1,1
.339.TBK2             1...
334..IBK2       INT  .,1,1,1,1
.341.REM        BCD  4K. PITCH AUTOPILOT DATA
.342.ALPUL            1.
.343.RFALPH           .5
.344.DELALA           .01
.345.PSH              -20.
.346.PSH2             -20.
.347.RFALP2           .5
.348.DELQC            ..
.349.DELQC2           ..
.35..TST              5.L
.351.DELQF            ..
.352.DELFD1           1.
.353.DELQTD           ..
F 54.DELQL            -15.
```

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```
DELQU
REM       BCD 4L. YAW AUTOPILOT DATA
RFB           .5
DELBA         .05
PSR           10.
RFPSI         .5
DPSIA         .05
PSPSI         -10.
DELRL         -35.
DELRU         35.
REM       BCD 4M. ROLL AUTOPILOT DATA
RFPHI         .5
DPHIA         .05
PSA           -15.
DELPL         -60.
DELPU         60.
REM       BCD 5N. THROTTLE AUTOPILOT DATA
TF        INT 0,1,1,0
NJF           0.,-1.,-1.,0.
IR        INT 1,1,1,1
NB            1.05,1.05,1.05,1.05
NLR           -2.,-2.,-2.,-2.
NTJ           2.,2.,2.,2.
K2            .5
K3            .5,.5,.5,.3333,.3333
K4            .5,.5,.5,.5,.3333,.3333,.3333,.3333
K4            .25,.25,.25
REM       BCD 4O. BRAKE AUTOPILOT DATA
MBC           0.,0.,0.,0.
PD            .01
DELTAW        .001
OMEGD1        20.
MBL           0.,0.,0.,0.
MBJ           3.E5,3.E5,3.E5,3.E5,3.E5
REM       BCD 5P. CONTROL RESPONSE DATA
DELHS         25.
DELRRD        35.
DELA          60.
NEDI          .125
REM       BCD 3Q. INITIALIZATION
IAP           1
HR            0.
DELQN         0.
DELQDE        .07227
DELQD         .07227
DELPD         0.
DELRD         0.
REM       BCD 4R. AUTOPILOT OUTPUT IND.
PITCHP        1
ROLLAP        1
THROAP        1
CONTRP        1
REM       BCD 2STAGING DATA
REM       BCD 4A. GEARS INTO PROGRAM
INDLG         0
ISTAGE        1
DEGRES    BCD 1HR
STESTD        25.
          TRA
INDLG         -1
REM       BCD 4B. SMOOTH IMPACT STAGE
AINCRS    BCD 4DDELT1DDELT2DDELT4DDELT5
STEST         -1.,-1.,-1.,-1.
          TRA
PRINT         .02
```

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ORIGINAL PAGE IS
OF POOR QUALITY

```
0420.DELTS          .01
0421.AMAXER         .001
0422.PRTMIN         0.
0423.REM      BCD 5C. EFFICIENT AMAXER STAGE
0424.AINCRS   BCD 4DELTA1DELTA2DELTA4DELTA5
0425.STEST          .1,.1,.1,.1
0426.         TRA
0427.PRINT          .08
0428.AMAXER         .04
0429.DELTS          .04
0430.REM      BCD 4D. SPOILER AERO STAGE
0431.AINCRS   BCD 1ISS
0432.STEST          1.
0433.         TRA
0434.ATAB10         .030,.030
0435.ATAB11         .1162,.1162
0436.ATAB12         0.,0.
0437.ATAB51         .3439,.3439
0438.ATAB52         -.0327,-.0327
0439.ATAB53         0.,0.
0440.ATAB80         .267,.267
0441.REM      BCD 3E. BOUNCE STAGE
0442.ISTAGE         1
0443.DEGRES   BCD 4DELTA1DELTA2DELTA4DELTA5
0444.STESTD         0.,0.,0.,0.
0445.         TRA
0446.PRINT          .02
04461DELTS          .01
0447.AMAXER         .001
0448.ISTAGE         1
0449.AINCRS   BCD 4DDELT1DDELT2DDELT4DDELT5
0450.STEST          .1,.1,.1,.1
0451.         TRA
0452.PRINT          .05
04521DELTS          .05
0453.AMAXER         .01
0454.ISTAGE         1
0455.DEGRES   BCD 4DELTA1DELTA2DELTA4DELTA5
0456.STESTD         0.,0.,0.,0.
0457.         TRA
0458.PRINT          .02
04581DELTS          .01
0459.AMAXER         .001
0460.ISTAGE         0
0461.AINCRS   BCD 4DDELT1DDELT2DDELT4DDELT5
0462.STEST          .1,.1,.1,.1
0463.         TRA
0464.PRINT          .05
04641DELTS          .05
0465.AMAXER         .01
0466.ISTAGE         1
0467.DEGRES   BCD 4DELTA1DELTA2DELTA4DELTA5
0468.STESTD         0.,0.,0.,0.
0469.REM      BCD 4F. STIFF STRUT STAGE
0470.AINCRS   BCD 1TIME
0471.STEST          20.
0472.         TRA
0473.INDLG          2
0474.AMAXER         .1
0475.DELTS          .1
0476.PRINT          .2
0477.FTAB03         2,0.,.2,100.,.2
0478.INDSTF         1
0479.         TRA
```

```
                 SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                       GENERALIZED COMPUTER PROGRAM

          INDSDF  2      CASE G-MOD         STAGE  1      PAGE     9

      A. GEARS INTO PROGRAM

      INITIAL PRINT OUT FOR VPCS
   XCGRF          AREFF          D1RFF          D2RFF
 0.          62.0000000E+02 30.9000000E+00 21.9000000E+01

      PRINT CODES IDENTIFYING TIME HISTORY
     2SDF
   TIME      TIMES     XG77F     YG77F     HGC7F     U777F     V777F     W777F
   PI77R     QI77R     RI77R     AMACH     VA77F     DYNPP     XG77F1    YG77F1
   ZG77F1    ALPHD     BETAD     ALPHD1    BETAD1    GAM7D     SIG7D     THTPD
   PSIPD     PHIPD     AX77F     AY77F     AZ77F     WTR7P     FOC       FCX
   FCY       FCZ
     VPCS
   AMASS
     TFFS
   MT        NT
     SAC1
   CAVAH     CA        CN        CY        CL        CM        CNN
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM


```
2SDF

 0.              0.              0.              0.              12.0824000E+01  21.8546595E+01  0.              25.2465006E+00
 0.              0.              0.              19.7138583E-02  22.0000000E+01  57.3183679E+00  21.9698498E+01  0.
 11.5139087E+00  65.8959907E-01  0.              0.              0.              -29.9999843E-01 0.              35.8959949E-01
 0.              0.              20.1439334E-01  0.              -32.1108781E+00 63.5850000E+04  0.              0.
 0.              0.

VPCS

19.7628520E+03

TFFS

28.4356654E+04 74.5058060E-16

                                                T(I)
 3.09067687E+04     -7.38268189E+03     -7.38268189E+03     3.09067687E+04

SAC1

15.3434214E-02 20.4914606E-03 17.8486439E-01  0.             0.             -18.8936665E-03  0.

                                        PITCH AUTOPILOT
AUTS
 DELON          ALPHAE         ALFHD1         ALPDD1         ALPHET         DELQDE

-14.3779512E-02 19.1993597E-03  0.             0.             19.1993597E-03-52.7766706E-02
                                        ROLL AUTOPILOT

 PHIE           PHIET          DELPCE

 0.             0.             0.

                                        THROTTLE AUTOPILOT
 ND(IN) =  1.97378031E+00   -1.00000000E+00   -1.00000000E+00   1.97378031E+00
 TD(IN) =  3.08687595E+04   -7.38268189E+03   -7.38268189E+03   3.08687595E+04
                                        CONTROL RESPONSE

 DELOD1         DELRD1         DELPC1         DELOD          DELRD          DELPD

-25.0000000E+00 35.0000000E+00 60.0000000E+00 72.2700000E-03  0.             0.

 ND1 = -1.25000000E-01    1.25000000E-01    1.25000000E-01   -1.25000000E-01
 N   =  1.97500000E+00   -1.00000000E+00   -1.00000000E+00    1.97500000E+00
INTEG RTN.      HT =  1.00000000E-01
INTEG RTN.      HT =  1.00000000E-01
```

```
INTEG RTN.       HT =  1.00000000E-01
INTEG RTN.       HT =  1.00000000E-01

     2SDF

40.0000000E-02 40.0000000E-02 87.0793850E+00 35.5110207E-19 11.6223554E+01 21.8555033E+01-10.8065681E-16 25.1565558E+00
28.7513541E-19-15.7240581E-04 42.6543901E-18 19.7133741E-02 21.9998079E+01 57.3250896E+00 21.9698062E+01 34.3643595E-18
11.4854711E+00 65.6607665E-01-49.3027758E-17-11.5358498E-02-23.6016210E-16-29.9260894E-01 89.6199421E-19 35.7346721E-01
 0.            35.4289448E-18 20.1092442E-01 20.9237527E-17-32.2083759E+00 63.5650000E+04  0.              0.
 0.             0.

     VPCS

19.7628520E+03

     TFFS

28.3060381E+04  0.

                                                T(I)
          3.07868409E+04      -7.38248338E+03      -7.38248338E+03      3.07868409E+04

     SAC1

15.3258307E-02 19.8841213E-03 17.9094376E-01 11.6354551E-18-64.3970611E-20-41.7857957E-03-78.4346920E-19

                                         PITCH AUTOPILOT
    AUTS
    DELON          ALPHAE          ALPHO1          ALPDO1          ALPHET          DELODE

-80.1994440E-03 19.6890172E-03-11.5358498E-02-62.2227817E-03-68.7884086E-04-80.1994440E-03
                                         ROLL AUTOPILOT

    PHIE           PHIET           DELPCE

35.4289448E-18 11.8193416E-17  0.

                                         THROTTLE AUTOPILOT
          ND(IN) =  1.97022306E+00     -1.00000000E+00     -1.00000000E+00      1.97022306E+00
          TD(IN) =  3.07580473E+04     -7.38248338E+03     -7.38248338E+03      3.07580473E+04
                                         CONTROL RESPONSE

    DELOD1         DELRD1          DELPC1          DELQD           DELRD           DELPD

25.3000000E+00 35.0000000E+00 59.0000000E+00-80.1994440E-03  0.              0.
            ND1 = -1.25000000E-01      1.25000000E-01      1.25000000E-01     -1.25000000E-01
            N   =  1.97022306E+00     -1.00000000E+00     -1.00000000E+00      1.97022306E+00
```

```
INTEG RTN.       HT =  1.00000000E-01
INTEG RTN.       HT =  1.00000000E-01
INTEG RTN.       HT =  1.00000000E-01
INTEG RTN.       HT =  1.00000000E-01

        2SOF

 80.0000000E-02 80.0000000E-02 17.5758142E+01 52.6938894E-18 11.1630024E+01 21.8566921E+01-67.7651415E-16 25.0315591E+00
 43.3598410E-19-12.1297457E-34 73.3957844E-18 19.7128433E-02 21.9995632E+01 57.3315257E+00 21.9695829E+01 25.1026657E-17
 11.4813221E+00 65.3338190E-01-17.7641547E-16-71.4547150E-03-41.2900642E-16-29.9156020E-01 65.4667322E-18 35.4182120E-01
  0.            12.1459851E-17 19.8445920E-01 75.5579131E-17-32.1209308E+00 63.5850000E+04  0.              0.
  0.             0.

        VPCS

 19.7628520E+03

        TFFS

 28.1768928E+04 74.5058060E-10

                                                                T(I)
                    3.06673466E+04      -7.38226577E+03      -7.38226577E+03       3.06673466E+04

        SAC1

 15.3062294E-02 20.6821668E-03 17.8588131E-01 41.9234051E-18-98.4620079E-20-23.8856300E-03-15.3527011E-18

                                                               PITCH AUTOPILOT
      AUTS
      DELON          ALPHAE          ALPHD1          ALPDD1          ALPHET          DELODE

-98.9700752E-04 13.4176623E-03-71.4547150E-03-68.4611440E-03 11.9208768E-03-24.8314544E-02
                                                               ROLL AUTOPILOT

      PHIE           PHIET           DELPCE

 12.1459851E-17 24.8519383E-17  0.

                                                               THROTTLE AUTOPILOT
                    ND(IN) =  1.96628536E+00      -1.00000000E+00      -1.00000000E+00       1.96628536E+00
                    TD(IN) =  3.06354917E+04      -7.38226577E+03      -7.38226577E+03       3.06354917E+04
                                                               CONTROL RESPONSE

      DELQD1         DELRD1          DELPC1          DELQD           DELRD           DELPD

-25.0000000E+00 35.0000000E+00 60.0000000E+00-24.8314544E-02  0.              0.
```

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM

                    INDSOF  2      CASE G-MOD         STAGE  1      PAGE      13

                  ND1 = -1.25000000E-01      1.25000000E-01      1.25000000E-01      -1.25000000E-01
                  N   =  1.96628536E+00     -1.00000000E+00     -1.00000000E+00       1.96628536E+00
INTEG RTN.     HT =  1.00000000E-01
INTEG RTN.     HT =  1.00000000E-01
INTEG RTN.     HT =  1.00000000E-01
INTEG RTN.     HT =  1.00000000E-01

     2SDF

12.00000000E-01 12.00000000E-01 26.3636097E+01 24.6241054E-17 10.7039491E+01 21.8578925E+01-13.9211762E-15 24.9066458E+00
55.6822729E-19-14.5205541E-04 10.3080377E-17 19.7123302E-02 21.9993380E+01 57.3380600E+00 21.9693997E+01 78.1666300E-17
11.4732316E+00 65.0070465E-31-36.4913792E-16-92.3742241E-03-51.4375782E-16-29.8948015E-01 20.3857095E-17 35.1122330E-01
0.                23.7845711E-17 19.7057893E-01 15.4598498E-16-32.1490342E+00 63.5650000E+04  0.              0.
0.              0.

     VPCS

19.7628520E+03

     TFFS

28.0339370E+04 74.5058060E-10

                                                           T(I)
               3.05350930E+04      -7.38205540E+03      -7.38205540E+03      3.05350930E+04

     SAC1

15.2844713E-02 20.7085939E-03 17.8723997E-01 86.1196548E-18-12.4719389E-19-30.9928098E-03-23.8704518E-18

                                                     PITCH AUTOPILOT
   AUTS

   DELON         ALPHAE         ALPHO1         ALPOD1         ALPHET         DELQDE

68.5056444E-03 98.4128298E-04-92.3742241E-03-75.4252783E-03 13.6681007E-04 68.5056444E-03
                                                     ROLL AUTOPILOT

   PHIE          PHIET          DELPCE

23.7845711E-17 40.0181486E-17  0.

                                                     THROTTLE AUTOPILOT
                  ND(IN) =  1.96192765E+00     -1.00000000E+00     -1.00000000E+00      1.96192765E+00
                  TD(IN) =  3.04998412E+04     -7.38205540E+03     -7.38205540E+03      3.04998412E+04
                                                     CONTROL RESPONSE

   DELQD1        DELRD1         DELPD1         DELQD          DELRD          DELPD
```

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                 GENERALIZED COMPUTER PROGRAM
                    INDSDF  2     CASE G-MOD        STAGE  1      PAGE      14
25.8000000E+00 35.0000000E+00 60.0000000E+00 68.5356444E-03  0.              0.
                         ND1 = -1.25000000E-01      1.25000000E-01      1.25000000E-01      -1.25000000E-01
                         N   =  1.96192765E+00     -1.00000000E+00     -1.00000000E+00       1.96192765E+00
INTEG RTN.     HT *   1.00000000E-01
INTEG RTN.     HT =   1.00000000E-01
INTEG RTN.     HT =   1.00000000E-01
INTEG RTN.     HT =   1.00000000E-01
       2SOF
16.0000000E-01 16.0000000E-01 35.1513266E+01 73.4319665E-17 10.2450771E+01 21.8590897E+01-23.0759506E-15 24.7813393E+00
61.8726712E-19-14.0777461E-04 12.7935919E-17 19.7118170E-02 21.9991125E+01 57.3445896E+00 21.9691935E+01 17.3802908E-16
11.4694696E+00 64.6792589E-01-60.4853446E-16-80.9199754E-03-65.6423813E-16-29.8853064E-01 45.3278954E-17 34.7939498E-01
 0.            37.7059693E-17 19.4896598E-01 25.6799597E-16-32.1160969E+00 63.5650000E+04  0.              0.
 0.             0.
       VPCS
19.7628520E+03
       TFFS
27.8756959E+04 74.5058060E-10
                                                         T(I)
                 3.03887124E+04       -7.38184498E+03       -7.38184490E+03       3.03887124E+04
       SAC1
15.2602817E-02 21.0853484E-03 17.8520581E-01 14.2745413E-17-13.8586312E-19-23.2268765E-03-32.6654120E-18
                                                     PITCH AUTOPILCT
     AUTS
     DELON          ALPHAE         ALFHD1         ALPDD1         ALPHET         DELQDE
15.6252715E-02 91.4973706E-04-80.9099754E-03-83.1963156E-03 10.2929072E-03-49.6054284E-03
                                                     ROLL AUTOPILOT
     PHIE           PHIET          DELPDE
37.7059693E-17 55.8920080E-17  0.
                                                     THROTTLE AUTOPILOT
                 ND(IN) =  1.95710504E+00     -1.00000000E+00     -1.00000000E+00       1.95710504E+00
                 TD(IN) =  3.03497021E+04     -7.38184498E+03     -7.38184498E+03       3.03497021E+04
                                                     CONTROL RESPONSE
```

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                 GENERALIZED COMPUTER PROGRAM

                        INDSOF  2      CASE G-MOD        STAGE  1     PAGE     15

      DELOD1          DELRD1          DELPC1          DELOD           DELRD           DELPD

-25.0000000E+00 35.0000000E+00 60.0000000E+00-49.6154284E-03  0.                0.

                       ND1 = -1.25000000E-01      1.25000000E-01      1.25000000E-01      -1.25000000E-01
                       N   =  1.95710504E+00     -1.00000000E+00     -1.00000000E+00       1.95710504E+00
INTEG RTN.       HT =  1.00000000E-01
INTEG RTN.       HT =  1.00000000E-01
INTEG RTN.       HT =  1.00000000E-01
INTEG RTN.       HT =  1.00000000E-01

        2SDF

 20.0000000E-01 20.0000000E-01 43.9389375E+01 17.0540540E-16 97.8627910E+00 21.8594115E+01-33.7300888E-15 24.7014872E+00
 64.2537897E-19 11.0516386E-04 14.8984212E-17 19.7109877E-02 21.9985341E+01 57.3492784E+00 21.9684826E+01 32.0813547E-16
 11.4946815E+00 64.4716618E-01-88.4100531E-16 13.9339637E-02-74.1280747E-16-29.9518386E-01 83.6710601E-17 34.5198117E-01
  0.            52.7085856E-17 18.6651022E-01 37.5389514E-16-31.6291761E+00 63.5850000E+04  0.                0.
  0.             0.

        VPCS

 19.7628520E+03

        TFFS

 27.3248010E+04 74.5058060E-10

                                                          T(I)
                 2.987935 43E+04      -7.38150495E+03      -7.38150495E+03       2.98793543E+04

        SAC1

 15.2333816E-02 22.8030381E-03 17.6911401E-01 20.8547725E-17-14.3923475E-19 44.3393094E-03-41.6348659E-18

                                                         PITCH AUTOPILOT
      AUTS

      DELON           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELODE

 92.8454120E-02-69.2833820E-02 13.9339637E-02 20.0000000E-02-72.3164062E-02 15.3917342E+00
                                                         ROLL  AUTOPILOT

      PHIE            PHIET           DELPDE

 52.7085853E-17 70.5800802E-17  0.

                                                         THROTTLE AUTOPILOT
                       ND(IN) =  1.45899272E+00     -1.00000000E+00     -1.00000000E+00       1.45899272E+00
                       TD(IN) =  1.48269787E+04     -7.38150495E+03     -7.38150495E+03       1.48269787E+04
```

```
                                                        CONTROL RESPONSE
     DELQD1           DELRD1           DELPC1           DELQD            DELRD            DELPD

25.0000000E+00 35.0000000E+00 60.0000000E+00 49.9940057E-01  0.              0.

                     ND1 = -1.25000000E-01       1.25000000E-01       1.25000000E-01       -1.25000000E-01
                     N   =  1.92950444E+00      -1.00000000E+00      -1.00000000E+00        1.92950444E+00
INTEG RTN.      HT =  1.00000000E-01
INTEG RTN.      HT =  1.00000000E-01
INTEG RTN.      HT =  1.00000000E-01
INTEG RTN.      HT =  1.00000000E-01
       2SDF

24.0000000E-01 24.0000000E-01 52.7251740E+01 33.7902083E-16 93.2201692E+00 21.8396583E+01-51.5521465E-15 25.8950223E+00
17.8839782E-18 19.4064129E-03 34.8760821E-17 19.7053999E-02 21.9926491E+01 57.3263907E+00 21.9617164E+01 53.0542325E-16
11.6602999E+00 67.6212950E-01-13.5245725E-15 10.7446706E-01-18.3333530E-15-30.3919355E-01 13.8412843E-16 37.2293504E-01
 0.            72.5270027E-17 18.6684113E-01 57.4181798E-16-32.2770711E+00 63.5650000E+04  0.              0.
 0.             0.
       VPCS

19.7628520E+03
       TFFS

25.6420746E+04 74.5358060E-10

                                                           T(I)
               2.83227188E+04      -7.37921394E+03      -7.37921394E+03      2.83227188E+04
       SAC1

15.2030876E-02 14.0477610E-03 17.9472471E-01 31.9179910E-17-40.0694353E-19 18.1781789E-03-83.1362422E-18

                                                        PITCH AUTOPILOT
     AUTS
     DELQN            ALPHAE           ALPHD1           ALPDD1           ALPHET           DELQDE

11.6602967E-01-41.7870497E-02 10.7446706E-01  0.              11.9363031E-02-12.2123095E-01
                                                        ROLL AUTOPILOT
     PHIE             PHIET            DELPDE

72.5270027E-17 10.9203655E-16  0.
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                 INDSDF  2      CASE G-H00        STAGE  1      PAGE     17

                                                   THROTTLE AUTOPILOT
            ND(IN) =  1.40695824E+00     -1.00000000E+00     -1.00000000E+00      1.40695824E+00
            TO(IN) =  1.32063452E+04     -7.37921394E+03     -7.37921394E+03      1.32063452E+04
                                                   CONTROL RESPONSE
     DELQ01          DELRD1          DELP01          DELQD           DELRD           DELPD

-25.0000000E+00 35.0000000E+00 60.0000000E+00 87.1261661E-02  0.               0.

            ND1 = -1.25000000E-01      1.25000000E-01      1.25000000E-01     -1.25000000E-01
            N   =  1.87950444E+00     -1.00000000E+00     -1.00000000E+00      1.87950444E+00
INTEG RTN.      HT =  1.00000000E-01
INTEG RTN.      HT =  1.00000000E-01
INTEG RTN.      HT =  1.00000000E-01
INTEG RTN.      HT =  1.00000000E-01
```


ORIGINAL PAGE IS OF POOR QUALITY

```
ATAB10      .030,.030
ATAB11      .1162,.1162
ATAB12      0.,0.
ATAB51      .3439,.3439
ATAB52      -.0327,-.0327
ATAB53      0.,0.
ATAB80      .267,.267
REM     BCD 3E. BOUNCE STAGE
ISTAGE      1
DECRES  BCD 4DELTA1DELTA2DELTA4DELTA5
STESTD      0.,0.,0.,0.
        TRA
```

2SDF

14.2132500E+00	14.2132500E+00	30.0115766E+02	20.0527051E-13	23.2688344E+00	19.1329943E+01	-41.1098943E-14	29.2126330E+00
-18.0603894E-16	-33.9212714E-03	-27.7133472E-17	17.3376473E-02	19.3547217E+01	44.4900298E+00	19.3547030E+01	55.0786099E-14
-26.9147507E-02	86.8199044E-01	-12.3107936E-14	-16.9599305E-01	39.0832741E-15	79.6763585E-03	16.3049358E-14	87.6066620E-01
0.	-61.4049161E-15	15.5320443E-01	14.5655725E-14	-31.4646109E+00	63.5650000E+04	0.	-0.
-0.	-0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	30.4700000E+03	37.5840000E+04	0.	19.4523283E-02	-15.0964299E+03	-32.3808397E+01	13.6130738E+04
0.	41.5382400E+03	34.6154400E+04	0.	33.7198033E-02	-30.0976160E+03	-22.7849641E+01	15.5806441E+04
0.	41.5382400E+03	34.6154400E+04	0.	33.7198033E-02	-30.0976160E+03	-22.7849641E+01	15.5806441E+04
68.6231949E-03	42.0798400E+03	34.6154400E+04	26.0894122E+03	37.8220153E-02	-30.4886440E+03	-33.3037470E+00	15.5529374E+04
68.6231949E-03	42.0798400E+03	34.6154400E+04	26.0994122E+03	37.6220153E-02	-30.4886440E+03	-33.3037470E+00	15.5529374E+04

HUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
53.3000000E-02	19.3261083E+01	0.	0.	-0.	0.	0.	-12.8274547E+00
53.3000000E-02	19.2917656E+01	0.	0.	-0.	0.	0.	-27.0320006E-01
53.3000000E-02	19.2917656E+01	0.	0.	-0.	0.	0.	-27.0320006E-01
65.6165216E-03	63.2620800E-02	17.4979834E+02	10.3878864E-10	-26.6670391E+03	33.9993308E+02	0.	68.6231949E-03
65.6165216E-03	63.2620800E-02	17.4979834E+02	10.3878864E-10	-26.6670391E+03	33.9993308E+02	0.	68.6231949E-03

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	20.7198857E-03	0.	0.	0.	37.7770342E+00	-99.5635567E+00
0.	0.	20.7198857E-03	0.	0.	0.	37.7770342E+00	-99.5635567E+00

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
11.5819410E+03	20.7716681E-10	-52.1788243E+03	74.6094339E-08	-00.9252459E+04	-23.2880613E-08	11.5819410E+03	20.7716681E-10

```
     FZM                LM                 MM                  NM
-52.1788243E+03 74.6094339E-08-80.9252459E+04-23.2880613E-08
      WPCS
 19.7628520E+03
      TFFS
 47.3604943E+02 18.6264515E-10

                                                                T(I)
                 4.45334947E+03      -6.40843537E+03      -6.40843537E+03       4.45334947E+03
      SAC1
 13.9973794E-02-82.3048755E-03 20.6511555E-01 29.0534729E-16 45.9797719E-17 10.1972271E-02-19.5568460E-17

                                                          PITCH AUTOPILOT
     AJIS
     DELON             ALPHAE            ALPHD1            ALPDD1             ALPHET            DELODE
 13.8666987E+00 78.1275532E-03-16.9599305E-01  0.                       88.9361407E-03 12.0879758E+00
                                                          ROLL AUTOPILOT
     PHIE              PHIET             DELPCE
-11.3339811E-15-10.8719756E-15  0.

                                                          THROTTLE AUTOPILOT
                 ND(IN) =  1.00000000E+00      -1.00000000E+00      -1.00000000E+00       1.00000000E+00
                 TD(IN) =  1.62326570E+04      -6.40843537E+03      -6.40843537E+03       1.62326570E+04
                                                          CONTROL RESPONSE
     DELQD1            DELRD1            DELPD1            DELQD              DELRD             DELPD
 25.0000000E+00 35.0000000E+00 60.0000000E+00 12.0879758E+00  0.                 0.
                   ND1 = -1.25000000E-01       1.25000000E-01       1.25000000E-01      -1.25000000E-01
                   N   =  1.11804565E+00      -1.00000000E+00      -1.00000000E+00       1.11804565E+00
INTEG RTN.      HT =  3.20000000E-02
INTEG RTN.      HT =  3.20000000E-02
      2SOF
 14.2932500E+00 14.2932500E+00 30.1662519E+02 20.4961952E-13 23.2375688E+00 19.0799790E+01-40.2368158E-14 29.9833849E+00
-17.2342905E-16-28.1853774E-03-31.7894154E-17 17.3312833E-02 19.3141292E+01 44.3036488E+00 19.3138425E+01 55.7600411E-14
```

10.5228168E-01	89.3073098E-01	-12.0828211E-14	31.7471641E-01	30.9633925E-15	-31.2162185E-02	16.5415516E-14	66.1856782E-01
0.	-68.8020098E-15	-27.7076000E-01	12.3454787E-14	-16.6597456E+00	63.5650000E+04	0.	-0.
-0.	-0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FG2
0.	30.4704000E+03	37.5840000E+04	0.	11.2041276E+00	-15.0622485E+03	-32.3075227E+01	13.6164919E+04
0.	41.5382400E+03	34.6154400E+04	0.	15.2408383E+00	-30.0513315E+03	-22.7499251E+01	15.5852725E+04
0.	41.5382400E+03	34.6154400E+04	0.	15.2408383E+00	-30.0513315E+03	-22.7499251E+01	15.5852725E+04
58.4055998E-03	42.0798400E+03	34.6154400E+04	21.5310687E+03	16.4014796E+00	-30.4388796E+03	-67.4352917E+00	15.5579139E+04
58.4055998E-03	42.0798400E+03	34.6154400E+04	21.5310687E+03	16.4014796E+00	-30.4388796E+03	-67.4352917E+00	15.5579139E+04

HUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
53.0000000E-02	19.2896331E+01	0.	0.	-0.	0.	0.	-12.6365515E+00
53.0000000E-02	19.2615377E+01	0.	0.	-0.	0.	0.	-26.6846361E-01
53.0000000E-02	19.2615377E+01	0.	0.	-0.	0.	0.	-26.6846361E-01
38.9152004E-03	37.4633752E-02	-84.2486217E+01	81.4117251E-11	-21.6492838E+03	-16.4559496E+02	0.	58.4055998E-03
38.9152004E-03	37.4633752E-02	-84.2486217E+01	81.4117251E-11	-21.6492838E+03	-16.4559496E+02	0.	58.4055998E-03

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	20.7198857E-03	0.	0.	0.	-18.2843885E+00	-98.3810889E+00
0.	0.	20.7198857E-03	0.	0.	0.	-18.2843885E+00	-98.3810889E+00

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
48.2259430E+02	16.5659063E-10	-43.0621373E+03	-30.6069469E-09	-76.4532536E+04	-59.5706964E-09	48.2259430E+02	16.5659063E-10

FZM	LM	MM	NM
-43.0621373E+03	-30.6069469E-09	-76.4532536E+04	-59.5706964E-09

VPCS

19.7628520E+03

TFFS

31.6419870E+02 18.6264515E-10

	T(I)		
4.29873437E+03	-6.39352614E+03	-6.39352614E+03	4.29873437E+03

SAC1

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                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                GENERALIZED COMPUTER PROGRAM

                  INDSOF  2      CASE G-MOD          STAGE  1      PAGE     135

 26.7000000E-02 20.1650888E-02 10.4186423E-01 28.5154577E-16 43.9688302E-17 30.8992824E-02-18.3438462E-17

                                                     PITCH AUTOPILCT
    AUTS
    DELON          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELODE

 13.6666987E+00 78.1275532E-03 31.7471641E-01  0.                88.9361407E-03 12.0879758E+00
                                                     ROLL AUTOPILOT

    PHIE           PHIET          DELPCE

-11.3339011E-15-10.8719796E-15  0.

                                                     THROTTLE AUTOPILOT
               ND(IN) =  1.00000000E+00      -1.00000000E+00      -1.00000000E+00       1.00000000E+00
               TD(IN) =  1.62177478E+04      -6.39352614E+03      -6.39352614E+03       1.62177478E+04
                                                     CONTROL RESPONSE
    DELOD1         DELRD1         DELPD1         DELOD          DELRD          DELPD

 25.0000000E+00 35.0000000E+00 60.0000000E+00 12.0879758E+00 11.1863587E-13  0.

               ND1 = -1.25000000E-01       1.25000000E-01       1.25000000E-01      -1.25000000E-01
               N   =  1.10804565E+00      -1.00000000E+00      -1.00000000E+00       1.10804565E+00
INTEG RTN.     HT =  6.00000000E-03
INTEG RTN.     HT =  1.20000000E-02
      2SDF

 14.3732503E+00 14.3732506E+00 30.3205939E+02 20.9463809E-13 23.1049040E+00 19.0275051E+01-38.8922498E-14 30.6893163E+00
-17.4850943E-16-24.3467534E-13-33.3473637E-17 17.2647957E-02 19.2734099E+01 44.1172095E+00 19.2721180E+01 56.9114183E-14
 22.3155596E-01 91.6228551E-01-11.7112656E-14 26.6961131E-01 53.8246167E-15-66.3408179E-02 16.9196952E-14 84.9887621E-01
  0.              -76.2619894E-15-22.5825575E-01 20.2193160E-14-19.1066496E+00 63.5650000E+04  0.                -0.
 -0.              -0.
    LGEAR
    DELTA          P              P2             FT             SR             SF             AA             FC2

  0.            30.4704000E+03 37.5840000E+04  0.             10.3819776E+00-15.0648349E+03-32.3130704E+01 13.6162333E+04
  0.            41.5382400E+03 34.6154400E+04  0.             12.7671577E+00-30.0590510E+03-22.7557690E+01 15.5845006E+04
  0.            41.5382400E+03 34.6154400E+04  0.             12.7671577E+00-30.0590510E+03-22.7557690E+01 15.5845006E+04
 10.3500468E-02 43.6219490E+03 34.6154400E+04 43.1212652E+03 13.4529483E+00-40.0507852E+03 23.2446237E+00 14.6291508E+04
 10.3500468E-02 43.6219490E+03 34.6154400E+04 43.1212652E+03 13.4529483E+00-40.0507852E+03 23.2446237E+00 14.6291508E+04
    MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 53.0000000E-02 19.2508784E+01  0.             0.            -0.             0.             0.            -12.3694625E+00
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                                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                        GENERALIZED COMPUTER PROGRAM

                    INDSDF  2      CASE G-MOD         STAGE  1      PAGE     136

53.0000000E-02 19.2269297E+01  0.             0.             -0.            0.             0.            -25.3296384E-01
53.0000000E-02 19.2269297E+01  0.             0.             -0.            0.             0.            -25.3296384E-01
11.3044622E-03 10.8473348E-02 49.3709082E+01 15.9599449E-10-43.6738231E+03 94.3559780E+01  0.             10.0500468E-02
11.3044622E-03 10.8473348E-02 49.3709082E+01 15.9599449E-10-43.6738231E+03 94.3559780E+01  0.             10.0500468E-02
     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

 0.             0.             0.             0.             0.             0.             0.             0.
 0.             0.             0.             0.             0.             0.             0.             0.
 0.             0.             0.             0.             0.             0.             0.             0.
48.7688237E-01 19.8077073E-01 76.8628070E-03  0.             0.             0.             10.4839976E+00-10.0473200E+01
48.7688237E-01 19.8077073E-01 76.8628070E-03  0.             0.             0.             10.4839976E+00-10.0473200E+01
     FTRA           FTRB           FTRC           HTX            HTY            HTZ            FXM            FYM

13.8856848E+03 32.3975353E-10-86.2425304E+03-69.5963915E-09-14.4512012E+05-11.3102906E-09 13.8856848E+03 32.3975353E-10
     FZM            LM             MM             NM

-84.9541147E+03 20.9165213E-09-14.1966962E+05-11.3102906E-09
      VPCS

19.7628520E+03
      TFFS

-12.3115435E+01  0.

                                                         T(I)
                  3.98554296E+03     -6.37856789E+03     -6.37856789E+03       3.98554296E+03
      SAC1

26.7000000E-02 19.6453848E-02 10.6977815E-01 27.6385867E-16 44.6901526E-17 29.8169821E-02-17.3825519E-17

                                                       PITCH AUTOPILOT
     AUTS
     DELON          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELODE

13.6666987E+00 78.1275532E-03 26.6961131E-01  0.             88.9361407E-03 12.0879758E+00
                                                       ROLL AUTOPILOT

     PHIE           PHIET          DELPDE

-11.3339811E-15-10.8719796E-15  0.
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SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE G-MOD STAGE 1 PAGE 137

THROTTLE AUTOPILOT

ND(IN) =	1.00000000E+00	-1.00000000E+00	-1.00000000E+00	1.00000000E+00
TD(IN) =	1.62027895E+04	-6.37856789E+03	-6.37856789E+03	1.62027895E+04

CONTROL RESPONSE

DELQD1	DELRD1	DELPD1	DELQD	DELRD	DELPD
25.0000000E+00	35.0000000E+00	60.0000000E+00	12.0879758E+00	0.	0.

ND1 =	-1.25000000E-01	1.25000000E-01	1.25000000E-01	-1.25000000E-01
N =	1.09804565E+00	-1.00000000E+00	-1.00000000E+00	1.09804565E+00

INTEG RTN. HT = 1.20000000E-02
INTEG RTN. HT = 1.20000000E-02

2SDF

14.4532500E+00	14.4532500E+00	30.4746068E+02	21.4170246E-13	22.8837139E+00	18.9771848E+01	-37.2598843E-14	31.3162679E+00
-19.3488562E-16	-21.9430407E-03	-39.7623934E-17	17.2293412E-02	19.2338407E+01	43.9365307E+00	19.2310432E+01	58.2909869E-14
32.8035252E-01	93.7053518E-01	-11.2494774E-14	24.2587621E-01	63.6523556E-15	-97.7231992E-02	17.3668557E-14	83.9330205E-01
0.	-84.1037202E-15	-21.7434152E-01	23.1994427E-14	-20.4314161E+00	63.5850000E+04	0.	-0.
-0.	-0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	30.4704000E+03	37.5840000E+04	0.	10.1236589E+00	-15.0656648E+03	-32.3148505E+01	13.6161503E+04
0.	41.5382400E+03	34.6154400E+04	0.	11.4270066E+00	-30.0632434E+03	-22.7589428E+01	15.5840813E+04
0.	41.5382400E+03	34.6154400E+04	0.	11.4270066E+00	-30.0632434E+03	-22.7589428E+01	15.5840813E+04
12.0064995E-02	49.1507473E+03	34.6154400E+04	54.4850474E+03	11.8017471E+00	-50.1245331E+03	33.0106416E+00	13.7381321E+04
12.0064995E-02	49.1507473E+03	34.6154400E+04	54.4850474E+03	11.8017471E+00	-50.1245331E+03	33.0106416E+00	13.7381321E+04

MUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
53.0000000E-02	19.2116405E+01	0.	0.	-0.	0.	0.	-12.0297349E+00
53.0000000E-02	19.1903110E+01	0.	0.	-0.	0.	0.	-23.0934032E-01
53.0000000E-02	19.1903110E+01	0.	0.	-0.	0.	0.	-23.0934032E-01
13.2884819E-03	12.7218142E-02	-73.0430103E+01	18.8573791E-10	-54.9671595E+03	-13.8168232E+02	0.	12.0064995E-02
13.2884819E-03	12.7218142E-02	-73.0430103E+01	18.8573791E-10	-54.9671595E+03	-13.8168232E+02	0.	12.0064995E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
12.9829914E+00	25.9308963E-01	24.9333344E-02	0.	0.	0.	-15.3520257E+00	-10.1154565E+01
12.9829914E+00	25.9308963E-01	24.9333344E-02	0.	0.	0.	-15.3520257E+00	-10.1154565E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
14.6016110E+03	38.6144305E-10	-10.8970095E+04	-10.6731509E-08	-16.8800565E+05	12.3320655E-08	14.6016110E+03	38.6144305E-10

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     FZM              LM               MM               NM
-10.5540139E+04-41.6961075E-10-18.2025260E+05 12.3320655E-08
       VPCS
 19.7628520E+03
       TFFS
-34.1613021E+02  0.

                                                          T(I)
                 3.67208804E+03     -6.36402991E+03     -6.36402991E+03      3.67208804E+03
       SAC1
 26.7000000E-02 19.1584587E-02 10.9487494E-01 26.5487667E-16 49.5696570E-17 26.8030455E-02 16.2668938E-16

                                                       PITCH AUTOPILCT
     AUTS
     DELQN            ALPHAE           ALPHD1           ALPDD1           ALPHET           DELQDE
 13.8666987E+00 78.1275532E-03 24.2587621E-01  0.                  88.9361407E-03 12.0879758E+00
                                                       ROLL AUTOPILOT
     PHIE             PHIET            DELPDE
-11.3339811E-15-10.8719796E-15  0.

                                                       THROTTLE AUTOPILOT
                 NO(IN) =  1.00000000E+00     -1.00000000E+00     -1.00000000E+00      1.00000000E+00
                 TO(IN) =  1.61882515E+04     -6.36402991E+03     -6.36402991E+03      1.61882515E+04
                                                       CONTROL RESPONSE
     DELQD1           DELRD1           DELPD1           DELQD            DELRD            DELPD
 25.0000000E+00 35.0000000E+00 60.0000000E+00 12.0879758E+00 11.2798279E-13  0.

                 ND1 = -1.25000000E-01      1.25000000E-01      1.25000000E-01     -1.25000000E-01
                 N   =  1.08804565E+00     -1.00000000E+00     -1.00000000E+00      1.08804565E+00
INTEG RTN.      HT =  1.20000000E-02
INTEG RTN.      HT =  1.20000000E-02
       2SDF
 14.5332500E+00 14.5332500E+00 30.6282937E+02 21.8799628E-13 22.5842038E+00 18.9286739E+01-35.3187105E-14 31.6284374E+08
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SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE G-HOO STAGE 1 PAGE 139

-19.1374932E-16	-21.2318613E-03	-41.4516732E-17	17.1940557E-02	19.1944698E+01	43.7572256E+00	19.1899208E+01	60.0044640E-14
41.7864912E-01	95.4250243E-01	-10.6996151E-14	18.3432813E-01	78.9992828E-15	-12.4743102E-01	17.9156682E-14	82.9507039E-01
0.	-92.4336930E-15	-13.9803373E-01	28.3381443E-14	-22.5722718E+00	63.5850000E+04	0.	-0.
-0.	-0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	30.4704000E+03	37.5840000E+04	0.	94.6372414E-01	-15.0677408E+03	-32.3193035E+01	13.6159427E+04
0.	41.5382400E+03	34.6154400E+04	0.	92.6060700E-01	-30.0700017E+03	-22.7640590E+01	15.5834055E+04
0.	41.5382400E+03	34.6154400E+04	0.	92.6060700E-01	-30.0700017E+03	-22.7640590E+01	15.5834055E+04
15.0385952E-02	59.8264785E+03	34.6154400E+04	72.9135732E+03	92.0220645E-01	-68.7338218E+03	31.6422023E+00	12.1018382E+04
15.0385952E-02	59.8264785E+03	34.6154400E+04	72.9135732E+03	92.0220645E-01	-68.7338218E+03	31.6422023E+00	12.1018382E+04

HUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
53.0000000E-02	19.1709128E+01	0.	0.	-0.	0.	0.	-11.6199589E+00
53.0000000E-02	19.1505340E+01	0.	0.	-0.	0.	0.	-20.0762269E-01
53.0000000E-02	19.1505040E+01	0.	0.	-0.	0.	0.	-20.0762269E-01
13.1040406E-03	12.5120147E-02	-96.3722743E+01	23.8333530E-10	-73.5439375E+03	-17.9375791E+02	0.	15.0385952E-02
13.1040406E-03	12.5120147E-02	-96.3722743E+01	23.8333530E-10	-73.5439375E+03	-17.9375791E+02	0.	15.0385952E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
90.0700654E-01	34.3102363E-01	49.2108880E-02	0.	0.	0.	-19.9306435E+00	-10.2531107E+01
90.0700654E-01	34.3102363E-01	49.2108880E-02	0.	0.	0.	-19.9306435E+00	-10.2531107E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
19.3132445E+03	49.0990843E-10	-14.5827146E+04	-73.7957530E-09	-25.3532245E+05	-27.7968325E-08	19.3132445E+03	49.0990843E-10

FZM	LM	MM	NM
-14.3447600E+04	-17.0595093E-08	-24.8831848E+05	-27.7968325E-08

VPCS

19.7628520E+03

TFFS

-67.1149788E+02 0.

T(I)

3.35846010E+03 -6.34956285E+03 -6.34956285E+03 3.35846010E+03

SAC1

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26.7000000E-02 18.7403054E-02 11.1559547E-01 25.2298516E-16 49.1287326E-17 28.6433387E-02-13.7427688E-17

                                                        PITCH AUTOPILOT
     AUTS
     DELON            ALPHAE          ALPHD1          ALPDD1           ALPHET          DELQDE
13.8666987E+00 78.1275532E-03 18.3432813E-01  0.               88.9361407E-03 12.0879758E+00
                                                        ROLL AUTOPILOT
     PHIE             PHIET           DELPCE
-11.3339811E-15-10.8719796E-15  0.

                                                        THROTTLE AUTOPILOT
                      ND(IN) =  1.00000000E+00      -1.00000000E+00      -1.00000000E+00       1.00000000E+00
                      TD(IN) =  1.61737845E+04      -6.34956285E+03      -6.34956285E+03       1.61737845E+04
                                                        CONTROL RESPONSE
     DELQD1           DELRD1          DELPD1          DELQD            DELRD           DELPD
25.0000000E+00 35.0000000E+00 60.0000000E+00 12.0879758E+00 11.3260496E-13  0.
                      ND1 = -1.25000000E-01       1.25000000E-01       1.25000000E-01      -1.25000000E-01
                      N   =  1.07804565E+00      -1.00000000E+00      -1.00000000E+00       1.07804565E+00
INTEG RTN.       HT =  1.20000000E-02
INTEG RTN.       HT =  1.20000000E-02
```

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                                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM

                         INDSDF  2      CASE G-MOD          STAGE  1      PAGE     302

                                                       THROTTLE AUTOPILOT
                   ND(IN) = -2.00000000E+00        -2.00000000E+00       -2.00000000E+00         -2.00000000E+00
                   TO(IN) =  3.10708549E+04        -2.12466332E+04       -2.12466332E+04          3.10708549E+04
                                                        CONTROL RESPONSE

      DELQD1          DELRD1          DELPD1          DELQD           DELRD           DELPD

 -25.0050000E+00-35.0000000E+00 60.0000000E+00 79.8597584E-01  0.             0.

                     ND1 = -1.25000000E-01        -1.25000000E-01       -1.25000000E-01         -1.25000000E-01
                     N   = -1.76500000E+00        -1.76500000E+00       -1.76500000E+00         -1.76500000E+00
 INTEG RTN.       HT =  6.00000000E-03
 INTEG RTN.       HT =  6.00000000E-03

       2SDF

  22.3732500E+00 22.3732500E+00 43.0286769E+02 25.2918226E-11 19.0502366E+00 11.9183677E+01-85.0441578E-12 23.6426833E-02
 -88.0621796E-14 68.6726824E-04 25.7875269E-13 10.6761475E-02 11.9183911E+01 16.8724334E+00 11.9182649E+01 36.3380235E-11
  54.8557848E-02 11.3658534E-02-40.8837136E-12 52.0597102E-02 24.0601550E-12-26.3710762E-02 17.4691148E-11-15.0052903E-02
  0.              -66.9620572E-12-99.8921245E-01 40.2594930E-11-31.9280837E+00 63.5850000E+04  0.              -0.
 -0.              -0.

       LGEAR

       DELTA           P               P2              FT              SR              SF              AA              FC2

  28.8632704E-02 19.4458833E+04 38.1005360E+04 97.3336991E+03 83.7391408E-03-95.8261293E+03 32.3363721E+00 73.4729449E+03
  24.6287152E-02 18.6227840E+04 34.9486843E+04 13.9103303E+04 24.9497412E-02-13.4890054E+04 31.8957911E+00 83.1646447E+03
  24.6287152E-02 18.6227840E+04 34.9486843E+04 13.9103303E+04 24.9497412E-02-13.4890054E+04 31.8957911E+00 83.1646447E+03
  23.1035820E-02 17.0687430E+04 34.9470939E+04 12.8069197E+04 29.7156483E-02-12.3860524E+04 31.8611434E+00 90.9160758E+03
  23.1035820E-02 17.0687430E+04 34.9470939E+04 12.8069197E+04 29.7156483E-02-12.3860524E+04 31.8611434E+00 90.9160759E+03

       MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

  97.1458305E-05 57.8887013E-04 94.4583805E+00-14.8317927E-07-97.3337855E+03 16.2754935E+01  0.             28.8632704E-02
  18.7347897E-02 11.1755188E-01-26.0735936E+03 16.1113623E-07-13.9172065E+04-46.0297707E+03 45.8285679E+03 24.6287152E-02
  18.7347897E-02 11.1755188E-01-26.0735936E+03 16.1119623E-07-13.9172065E+04-46.0297707E+03 45.8285679E+03 24.6287152E-02
  18.3767901E-02 10.9619839E-01-23.5464204E+03 24.9951665E-07-12.8131302E+04-41.9274667E+03 41.6608659E+03 23.1035820E-02
  18.3767901E-02 10.9619839E-01-23.5464204E+03 24.9951665E-07-12.8131302E+04-41.9274668E+03 41.6608660E+03 23.1035820E-02

       SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

  24.6221578E-02 53.4109467E-03 97.2669628E-02  0.              0.             20.8292787E-03 30.1398027E-01-69.2427527E+00
 -28.6011452E-03 36.8289422E-02 12.6552436E-01  0.              0.             20.8278917E-03-22.3558695E-01-66.9458352E+00
 -28.6011453E-03 36.8289422E-02 12.6552436E-01  0.              0.             20.8278917E-03-22.3558695E-01-66.9458352E+00
 -15.5897798E-03 47.4913794E-02 12.3276186E-01  0.              0.             20.7294346E-03-29.6223104E-01-66.3845254E+00
 -15.5897795E-03 47.4913794E-02 12.3276186E-01  0.              0.             20.7294346E-03-29.6223104E-01-66.3845254E+00

       FTRA            FTRB            FTRC            HTX             HTY             HTZ             FXH             FYH

 -10.0800228E+04 78.5549828E-07-63.1678698E+04 34.8302637E-06-13.0652766E+05-12.3468680E-06-10.0800228E+04 78.5549828E-07
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2   CASE G-MOD   STAGE 1   PAGE 303

```
     FZM            LM            MM            NM
-63.1678893E+04 35.2495356E-06-13.0733541E+05-12.3468680E-06
       VPCS
 19.7628520E+03
       TFFS
-30.1864540E+04-74.5058060E-10

                                                     I(I)
           -1.71513943E+04     -1.71513943E+04     -1.71513943E+04     -1.71513943E+04
       SAC1
 26.7000000E-02 26.7753701E-02-64.0489830E-04 96.4855640E-14 36.4081347E-14 52.1440509E-02-84.7025384E-14

                                                  PITCH AUTOPILOT
     AUTS
     DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE
 13.8666987E+00 78.1275532E-03 52.0597102E-02  0.             88.9361407E-03 79.0597584E-01
                                                  ROLL AUTOPILOT
     PHIE           PHIET          DELPDE
-11.3339811E-15-10.8719796E-15  0.

                                                  THROTTLE AUTOPILOT
               ND(IN) = -2.00000000E+00     -2.00000000E+00     -2.00000000E+00     -2.00000000E+00
               TD(IN) =  3.10003692E+04     -2.11761475E+04     -2.11761475E+04      3.10003692E+04
                                                  CONTROL RESPONSE
     DELQD1         DELRD1         DELPD1         DELQD          DELRD          DELPD
-25.0000000E+00 35.0000000E+00 60.0000000E+00 79.0597584E-01 14.6865746E-13  0.
                 ND1 = -1.25000000E-01     -1.25000000E-01     -1.25000000E-01     -1.25000000E-01
                 N   = -1.77500000E+00     -1.77500000E+00     -1.77500000E+00     -1.77500000E+00
INTEG RTN.     HT =  6.00000000E-03
INTEG RTN.     HT =  3.00000000E-03
       2SDF
 22.4532500E+00 22.4532500E+00 43.1237014E+02 28.3056958E-11 19.0083937E+00 11.8375627E+01-79.2039133E-12 21.7684941E-02
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INOSDF 2 CASE G-MOD STAGE 1 PAGE 304

```
-74.4846541E-14 64.2620416E-04 25.3398892E-13 10.6937602E-02 11.8375927E+01 16.6444342E+00
 46.3715255E-02 10.5324306E-02-38.3360162E-12-72.5360095E-02 38.9523165E-12-22.4445905E-02 11.8374919E+01 39.0318145E-11
  0.            -70.8309062E-12-10.2597046E+00 42.7463416E-11-34.4518218E+00 63.5850000E+04 18.8917756E-11-11.9121814E-02
 -0.             -0.                                                                         0.              -0.
     LGEAR

     DELTA            P              P2              FT              SR              SF              AA              FC2

29.3199308E-02 19.8529620E+04 38.1005360E+04 99.3717486E+03-14.9016742E-01-97.8257106E+03 33.1614881E+00 71.8713970E+03
26.1433491E-02 20.1664061E+04 34.9486843E+04 15.0283444E+04-22.9563343E-01-14.5540065E+04 32.8582127E+00 75.3626690E+03
26.1433490E-02 20.1664061E+04 34.9486843E+04 15.0283444E+04-22.9583343E-01-14.5940565E+04 32.8582127E+00 75.3626690E+03
24.7979699E-02 18.7740156E+04 34.9470939E+04 14.0356962E+04-25.2747976E-01-13.6021270E+04 32.8227235E+00 82.3435048E+03
24.7979699E-02 18.7740156E+04 34.9470939E+04 14.0356962E+04-25.2747976E-01-13.6021270E+04 32.8227235E+00 82.3435048E+03
     MUVP           VGPT            FTRX            FTRY            FTRZ            MA              MB             DDELTA

14.2320426E-04 84.3149472E-04 14.1426183E+01-15.3593495E-07-99.3716693E+03 24.3036185E+01  0.             29.3199308E-02
17.9968871E-02 10.6619357E-01-27.0559839E+03 16.6223510E-07-15.0337320E+04-47.3542626E+03 47.2354338E+03 26.1433491E-02
17.9968871E-02 10.6619357E-01-27.0559839E+03 16.6223511E-07-15.0337320E+04-47.3542626E+03 47.2354338E+03 26.1433490E-02
18.0529407E-02 10.6951532E-01-25.3481278E+03 26.5202275E-07-14.0409966E+04-44.7061458E+03 44.4975375E+03 24.7979699E-02
18.0529407E-02 10.6951532E-01-25.3481279E+03 26.5202275E-07-14.0409966E+04-44.7061459E+03 44.4975375E+03 24.7979699E-02
     SD2             SD1              S              S2D2            S2D1             S2             OMETD1          OMET

-50.2609791E-02 25.5539581E-03 97.6311847E-02  0.                                                   
-16.1155121E-01 29.7905158E-02 12.9300925E-01  0.              0.              20.8292707E-03 45.0067010E-01-68.9536273E+00
-16.1155121E-01 29.7905158E-02 12.9300925E-01  0.              0.              20.8278917E-03-13.2031959E-01-67.0883715E+00
-18.7868673E-01 39.0369140E-02 12.6834678E-01  0.              0.              20.8278917E-03-13.2031959E-01-67.0883715E+00
-18.7868670E-01 39.0369140E-02 12.6834678E-01  0.              0.              20.7294346E-03-23.1787024E-01-66.5747831E+00
                                                               0.              20.7294346E-03-23.1787024E-01-66.5747831E+00
     FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

-10.6082136E+04 83.5453141E-07-58.6646561E+04 60.8655467E-06-17.9290115E+05-16.1301907E-06-10.6082136E+04 83.5453141E-07
     FZM             LM              MM              NM

-68.1592573E+04 61.3528176E-06-18.0184898E+05-16.1301907E-06
     VPCS

19.7628520E+03
     TFFS

-30.3835701E+04-74.5058060E-10


                                                       T(I)
              -1.72633921E+04      -1.72633921E+04      -1.72633921E+04      -1.72633921E+04
     SAC1
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                                 SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                      GENERALIZED COMPUTER PROGRAM
                        INDSDF  2      CASE G-MOD         STAGE  1      PAGE     305

 26.7000000E-02 26.7698988E-02-69.9161662E-04 50.4729983E-14 31.0049055E-14 54.3845628E-02-83.3779489E-14

                                                         PITCH AUTOPILOT
     AUTS
     DELON            ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE
 13.8666987E+00 78.1275532E-03-72.5360098E-02  0.              88.9361407E-03 78.2597584E-01
                                                         ROLL AUTOPILOT
     PHIE             PHIET           DELPOE
-11.3339811E-15-10.8719796E-15  0.

                                                         THROTTLE AUTOPILOT
                         ND(IN) = -2.00000000E+00     -2.00000000E+00      -2.00000000E+00      -2.00000000E+00
                         TD(IN) =  3.09279818E+04     -2.11037602E+04      -2.11037602E+04       3.09279818E+04
                                                         CONTROL RESPONSE
     DELQD1           DELRD1          DELPD1          DELQD           DELRD           DELPD
-25.0000000E+00 35.0000000E+00 60.0000000E+00 78.2597584E-01 14.8877546E-13  0.

                           ND1 = -1.25000000E-01     -1.25000000E-01      -1.25000000E-01      -1.25000000E-01
                           N   = -1.78500000E+00     -1.78500000E+00      -1.78500000E+00      -1.78500000E+00
INTEG RTN.         HT =   6.00000000E-03
INTEG RTN.         HT =   6.00000000E-03
      2SDF
 22.5332500E+00 22.5332500E+00 43.2180692E+02 31.5388936E-11 18.9808539E+00 11.7542196E+01-71.4715787E-12 10.3613968E-03
-54.6144017E-14 47.0542249E-04 24.8463385E-13 10.5290850E-02 11.7542197E+01 16.4108450E+00 11.7542024E+01 41.8022673E-11
 26.1487453E-02 50.5064801E-04-34.8397212E-12-16.8664448E-01 47.1037495E-12-98.2144458E-03 20.3764867E-11-93.1641775E-03
  0.           -73.9172728E-12-10.5228692E+00 43.6785609E-11-36.1880316E+00 63.5850000E+04  0.             -0.
 -0.            -0.
     LGEAR
     DELTA            P               P2              FT              SR              SF              AA              FD2
 29.2816830E-02 19.8179538E+04 38.1005360E+04 99.2008845E+03-22.5768129E-01-97.6464170E+03 33.3422943E+00 72.0164602E+03
 27.2181337E-02 21.2866252E+04 34.9486843E+04 15.8329745E+04-40.5407965E-01-15.3876187E+04 33.7150168E+00 69.7836733E+03
 27.2181337E-02 21.2866252E+04 34.9486843E+04 15.8329745E+04-40.5407965E-01-15.3876187E+04 33.7150168E+00 69.7836733E+03
 26.0859282E-02 20.1076791E+04 34.9470939E+04 14.9966432E+04-45.7058285E-01-14.5402784E+04 33.7914053E+00 75.7682395E+03
 26.0859282E-02 20.1076791E+04 34.9470939E+04 14.9966432E+04-45.7058285E-01-14.5402784E+04 33.7914053E+00 75.7682395E+03
     MUVP             VGPT            FTPX            FTRY            FTRZ            MA              MB              DDELTA
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ORIGINAL PAGE IS
OF POOR QUALITY

C-3

ORIGINAL PAGE IS OF POOR QUALITY


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26.1831389E-04 15.3987202E-03 25.9738291E+01-15.6317322E-07-99.2015933E+03 44.6450946E+01  0.             29.2816630E-02
17.9295677E-02 10.5446798E-01-28.3961549E+03 16.4504680E-07-15.8376127E+04-49.3946759E+03 49.6484353E+03 27.2181337E-02
17.9295677E-02 10.5446798E-01-28.3961549E+03 16.4504688E-07-15.8376127E+04-49.3946759E+03 49.6484353E+03 27.2181337E-02
17.8790562E-02 10.5149771E-01-26.8025310E+03 27.1741909E-07-14.9910212E+04-46.9260513E+03 47.0839520E+03 26.0859282E-02
17.8790562E-02 10.5149772E-01-26.8025310E+03 27.1741909E-07-14.9910212E+04-46.9260513E+03 47.0839520E+03 26.0859282E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-16.8934447E-01-42.9127418E-03 97.6024531E-02  0.             0.             20.8292787E-03 82.6761011E-01-68.4403147E+00
-25.1302034E-01 12.6687542E-02 13.1045938E-01  0.             0.             20.8278917E-03 28.1954909E-01-67.0134625E+00
-25.1302034E-01 12.6687542E-02 13.1045938E-01  0.             0.             20.8278917E-03 28.1954908E-01-67.0134625E+00
-29.5313515E-01 18.7117176E-02 12.9197103E-01  0.             0.             20.7294346E-03 17.5445270E-01-66.5818244E+00
-29.5313565E-01 18.7117176E-02 12.9197103E-01  0.             0.             20.7294346E-03 17.5445269E-01-66.5818244E+00

     FTRA           FTRB           FTRC           HTX            HTY            HTZ            FXM            FYM

-11.1301350E+04 85.4843755E-07-71.5593239E+04 86.8398960E-06-22.9831560E+05-21.2137189E-06-11.1301350E+04 85.4843755E-07

     FZM            LM             MM             NM

-71.7088120E+04 86.8484234E-06-23.1159337E+05-21.2137189E-06

      VPGS

 19.7628523E+03

      TFFS

-30.5756552E+04-74.5058060E-10

                                                        T(I)
                -1.73725314E+04    -1.73725314E+04    -1.73725314E+04    -1.73725314E+04

      SAC1

 26.7000000E-02 26.7034306E-02-18.6902239E-03 82.2193821E-14 22.8949664E-14 56.8998091E-02-81.4934802E-14

                                                    PITCH AUTOPILOT
     AUTS
     DELON          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELODE

 13.8666987E+00 78.1275532E-03-16.8404448E-01  0.             88.9361407E-03 77.4597584E-01
                                                    ROLL AUTOPILOT

     PHIE           PHIET          DELPDE

-11.3339811E-15-16.8719796E-15  0.
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                                        THROTTLE AUTOPILOT
                  ND(IN) = -2.00000000E+00       -2.00000000E+00       -2.00000000E+00        -2.00000000E+00
                  TO(IN) =  3.08533067E+04       -2.10290850E+04       -2.10290850E+04         3.08533067E+04
                                        CONTROL RESPONSE

      DELQD1           DELRD1           DELPC1           DELQD            DELRD            DELPD

-25.0000000E+00 35.0000000E+00 60.0000000E+00 77.4597584E-01 15.0996644E-13  0.

                  ND1 = -1.25000000E-01       -1.25000000E-01       -1.25000000E-01        -1.25000000E-01
                  N   = -1.79500000E+00       -1.79500000E+00       -1.79500000E+00        -1.79500000E+00
INTEG RTN.     HT =  1.20000000E-02
INTEG RTN.     HT =  6.00000000E-03

     2SDF

 22.6132500E+00 22.6132500E+00 43.3117626E+02 34.9925526E-11 18.9781952E+00 11.6692318E+01-63.4409163E-12-29.4048241E-02
-29.4752871E-14 18.9391996E-04 25.1063334E-13 10.4529884E-02 11.6692688E+01 16.1744923E+00 11.6692609E+01 44.5215072E-11
-13.5623696E-02-14.4377037E-02-31.1494092E-12-18.9859592E-01 41.9127539E-12 66.5912021E-03 21.8599488E-11-77.7861410E-03
  0.           -75.9274175E-12-10.6186064E+00 42.6318839E-11-36.2358182E+00 63.5850000E+04  0.              -0.
 -0.           -0.

     LGEAR

     DELTA            P               P2              FT              SR              SF              AA              FC2

 28.5052545E-02 19.1262535E+04 38.1005350E+04 95.7437226E+03-16.4046254E-01-94.2062101E+03 32.9786231E+00 74.7803365E+03
 27.3356574E-02 21.4141723E+04 34.9486843E+04 15.9221698E+04-41.1699996E-01-15.4749561E+04 33.8556654E+00 69.1786788E+03
 27.3356574E-02 21.4141723E+04 34.9486843E+04 15.9221698E+04-41.1699996E-01-15.4749561E+04 33.8556654E+00 69.1786788E+03
 26.3779945E-02 20.4174960E+04 34.9470939E+04 15.2046565E+04-48.2905778E-01-14.7557504E+04 33.9837862E+00 74.2654253E+03
 26.3779945E-02 20.4174960E+04 34.9470939E+04 15.2046565E+04-48.2905778E-01-14.7557504E+04 33.9837862E+00 74.2654253E+03

     MUVP            VGFT            FTRX            FTRY            FTRZ            MA              MD             DDELTA

 39.1193802E-04 22.8316730E-03 37.4541864E+01-16.0531897E-07-95.7433024E+03 64.6689022E+01  0.             28.5052545E-02
 18.3607601E-02 10.5407249E-01-28.7637282E+03 15.6632409E-07-15.9210895E+04-50.0002599E+03 50.7705872E+03 27.3356574E-02
 18.3607601E-02 10.5407249E-01-28.7637282E+03 15.6632409E-07-15.9210895E+04-50.0002599E+03 50.7705872E+03 27.3356574E-02
 18.0572232E-02 10.5386614E-01-27.4621452E+03 26.9453261E-07-15.2083988E+04-48.0007006E+03 48.7076994E+03 26.3779945E-02
 18.0572232E-02 10.5386614E-01-27.4621452E+03 26.9453261E-07-15.2083988E+04-48.0007006E+03 48.7076995E+03 26.3779945E-02

     SD2             SD1              S              S2D2            S2D1            S2             OMETD1          OMET

-83.5809762E-02-11.4805749E-02 96.9731176E-02  0.               0.             20.8292787E-03 11.9757226E+00-67.6167310E+00
-24.3535496E-01-79.0431134E-03 13.1233046E-01  0.               0.             20.8278917E-03 85.5919274E-01-66.5422845E+00
-24.3530495E-01-79.0431134E-03 13.1233046E-01  0.               0.             20.8278917E-03 85.5919273E-01-66.5422845E+00
-30.1924196E-01-59.8654433E-03 12.9701731E-01  0.               0.             20.7294346E-03 78.5554267E-01-66.1778234E+00
-30.1924196E-01-59.8654433E-03 12.9701731E-01  0.               0.             20.7294346E-03 78.5554267E-01-66.1778234E+00

     FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

-11.3052464E+04 83.6141508E-07-71.8280249E+04 99.9308973E-06-26.3551129E+05 87.4265802E-06-11.3052464E+04 83.6141508E-07
```

```
     FZM             LM              MM              NM
-71.9760243E+04 10.0708435E-05-26.4975180E+05 87.4265802E-06
      VPCS
 19.7628520E+03
      TFFS
-30.7639830E+04  0.

                                                          T(I)
               -1.74795358E+04     -1.74795358E+04     -1.74795358E+04     -1.74795358E+04
      SAC1
 26.7000000E-02 26.7851486E-02-36.3311515E-03 73.5126058E-14 12.4463220E-14 58.6029182E-02-82.0844847E-14

                                                    PITCH AUTOPILOT
     AUTS
     DELON           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE
 13.8666987E+00 78.1275532E-03-18.9859592E-01  0.             88.9301407E-03 76.6597584E-01
                                                    ROLL AUTOPILOT
     PHIE            PHIET           DELPDE
-11.3339811E-15-10.8719796E-15  0.

                                                    THROTTLE AUTOPILOT
               ND(IN) = -2.00000000E+00     -2.00000000E+00     -2.00000000E+00     -2.00000000E+00
               TD(IN) =  3.07772101E+04     -2.09529884E+04     -2.09529884E+04      3.07772101E+04
                                                    CONTROL RESPONSE
     DELQD1          DELRD1          DELPD1          DELQD           DELRD           DELPD
-25.0000000E+00-35.0000000E+00 60.0000000E+00 76.6597584E-01  0.             0.

                 NC1 = -1.25000000E-01     -1.25000000E-01     -1.25000000E-01     -1.25000000E-01
                 N   = -1.80500000E+00     -1.80500000E+00     -1.80500000E+00     -1.80500000E+00
INTEG RTN.     HT =  6.00000000E-03
INTEG RTN.     HT =  6.00000000E-03
      2SDF
 22.6932500E+00 22.6932500E+00 43.4047800E+02 38.6986023E-11 19.0006721E+00 11.5852307E+01-57.3755531E-12-55.8154188E-02
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE G-MOD STAGE 1 PAGE 309

```
-30.4992927E-15-13.2067549E-04 26.1744902E-13 10.3778308E-02 11.5853651E+01 15.9427243E+00 11.5852948E+01 47.1028767E-11
-40.3627414E-02-27.6037935E-02-28.3755655E-12-12.7739817E-01 26.8256730E-12 19.9616697E-02 23.2946183E-11-76.4223516E-03
 0.              -76.6728337E-12-10.4737180E+00 40.5878065E-11-34.5547901E+00 63.5850000E+04  0.              -0.
-0.              -0.
```

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
27.2333988E-02	18.0054580E+04	38.1005360E+04	90.1455163E+03	14.8316867E-02	-88.6535443E+03	32.0016796E+00	79.2371109E+03
26.4458882E-02	20.5239359E+04	34.9486843E+04	15.2552796E+04	-24.3842484E-01	-14.8197174E+04	32.9736055E+00	73.8578620E+03
26.4458832E-02	20.5239359E+04	34.9486843E+04	15.2552796E+04	-24.3842484E-01	-14.8197174E+04	32.9736055E+00	73.8578620E+03
25.5454471E-02	19.5988245E+04	34.9473939E+04	14.5870546E+04	-31.8216589E-01	-14.1490941E+04	33.1551645E+00	78.6093679E+03
25.5454471E-02	19.5988245E+04	34.9473939E+04	14.5870546E+04	-31.8216589E-01	-14.1490941E+04	33.1551645E+00	78.6093679E+03

MUVP	VGPT	FTRX	FTRY	FTRZ	HA	HM	DDELTA
43.9821323E-04	25.4722398E-03	39.6477202E+01	-16.4372579E-07	-90.1450616E+03	68.9605490E+01	0.	27.2333988E-02
18.3689295E-02	10.6383499E-01	-28.0292078E+03	14.7333793E-07	-15.2593317E+04	-48.9728314E+03	50.1055994E+03	26.4458882E-02
18.3689295E-02	10.6383499E-01	-28.0292078E+03	14.7333793E-07	-15.2590317E+04	-48.9728314E+03	50.1055994E+03	26.4458882E-02
18.3399744E-02	10.6215789E-01	-26.7591935E+03	26.1797170E-07	-14.5906368E+04	-46.9947989E+03	48.1253300E+03	25.5454471E-02
18.3399744E-02	10.6215790E-01	-26.7591936E+03	26.1797170E-07	-14.5906368E+04	-46.9947990E+03	48.1253300E+03	25.5454471E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
-23.9849223E-03	-15.4995612E-02	95.8459455E-02	0.	0.	20.8292787E-03	12.7734720E+00	-66.6091443E+00
-16.3879373E-01	-24.8703522E-02	12.9878561E-01	0.	0.	20.8278917E-03	12.5863111E+00	-65.6853982E+00
-16.3879373E-01	-24.8703522E-02	12.9878561E-01	0.	0.	20.8278917E-03	12.5863111E+00	-65.6853982E+00
-22.3097274E-01	-27.1350467E-02	12.8333662E-01	0.	0.	20.7294346E-03	12.5614561E+00	-65.3495619E+00
-22.3097274E-01	-27.1350467E-02	12.8333662E-01	0.	0.	20.7294346E-03	12.5614561E+00	-65.3495619E+00

FTRA	FTRD	FTRC	HTX	HTY	HTZ	FXM	FYM
-11.0096742E+04	79.5507718E-07	-58.6992194E+04	97.3784683E-06	-26.6799701E+05	88.3374326E-06	-11.0096742E+04	79.5507718E-07

FZM	LM	MM	NM
-68.9037733E+04	97.5136702E-06	-26.8002808E+05	88.3374326E-06

VPCS

19.7628520E+03

TFFS

-30.9521977E+04-74.5058060E-10

T(I)

-1.75864759E+04 -1.75864759E+04 -1.75864759E+04 -1.75864759E+04

SAC1

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                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                         GENERALIZED COMPUTER PROGRAM

          INDSOF  2      CASE G-MOD        STAGE  1      PAGE    310

26.7000000E-02 26.8570614E-02-51.8296019E-03 66.9663819E-14 12.9719921E-15 58.8331616E-02-85.5820727E-14

                                                     PITCH AUTOPILOT
     AUTS
     DELON          ALPHAE         ALPHO1         ALPDD1         ALPHET         DELODE

13.8666987E+00 78.1275532E-03-12.7739617E-01  0.             88.9361407E-03 75.8597584E-01
                                                     ROLL AUTOPILOT

     PHIE           PHIET          DELPOE

-11.3339811E-15-10.8719796E-15  0.

                                                     THROTTLE AUTOPILOT
                    ND(IN) = -2.00000000E+00      -2.00000000E+00      -2.00000000E+00      -2.00000000E+00
                    TD(IN) =  3.07020524E+04      -2.08778308E+04      -2.08778308E+04       3.07020524E+04
                                                     CONTROL RESPONSE

     DELQD1         DELRD1         DELPD1         DELQD          DELRD          DELPD

-25.0000000E+00 35.0000000E+00 60.0000000E+00 75.8597584E-01 15.5430307E-13  0.

                    ND1 = -1.25000000E-01       -1.25000000E-01      -1.25000000E-01      -1.25000000E-01
                    N   = -1.81500000E+00       -1.81500000E+00      -1.81500000E+00      -1.81500000E+00
INTEG RTN.      HT =  3.00000000E-03
INTEG RTN.      HT =  3.00000000E-03
```


ORIGINAL PAGE IS
OF POOR QUALITY

APPENDIX E

AIRPLANE B RIGID BODY EXAMPLE 2

```
F CASE TAB
ATAB.1      2
ATAB.2      2
ATAB00      2
ATAB10      2
ATAB11      2
ATAB12      2
ATAB15      2
ATAB16      2
ATAB51      2
ATAB52      2
ATAB53      2
ATAB56      2
ATAB57      2
CTAB.1      13
CTAB.2      13
FTAB.2      5
FTAB.3      20
TTAB10      50
VTAB.1      5
VTAB.2      5
VTAB.3      5
VTAB.4      5
VTAB.6      5
       TRA
REM    BCD 3SDF2-PLANPLANE
NCASE  BCD 1LROLL
REM    BCD 4INTEGRATION INFORMATION
IVARBH      0
TMAX        400.
AMINER      .00005
PRTMIN      .0
AMAXER      .001
DELTS       .001
PRINT       .05
REM    BCD 3REQD FOR SDF-2
AMASS       3874.899
HGC7F       1000.
GAM7D       -1.06060
VG77F       296.22076
THTBD       10.3394
RHHGR       .0
INDAPC      1
INDACD      1
INDFPA      1
INDPLA      1
INDACM      2
INDGRT      1
INDWGT      1
REM    BCD 5VEHICLE PHYSICAL PROP. DATA
INDVPC      1
XCGRF       .0
VTAB.1      2,0.,0.,5000.,1.
VTAB.2      2,0.,1.597022E+6,5000.,1.597022E+6
VTAB.3      2,0.,1.597022E+6,5000.,1.597022E+6
VTAB.4      2,0.,1.597022E+6,5000.,1.597022E+6
INDXZS      1
VTAB.6      2,0.,1.00E+5,5000.,1.00E+5
REM    BCD 4AERODYNAMIC INPUT DATA
INDAER      1
AREFF       1605.
D1RFF       37.7
D2RFF       56.7
INDA.1      1
ATAB.1      -7.3573427E-3,-5.5941985E-3
```

```
 ATAB.2    * 1.4.2.979E-3,8.8931664E-4
 INDA.2      1
 INDA80      1
 ATAB80      4.18951E-2,2.0.844E-2
 INDA10      1
 ATAB10      -3.978321E-2,-3.9653349E-2
 INDA11      1
 ATAB11      5.7452448E-2,3.7645688E-2
 INDA12      1
 ATAB12      1.472.279E-3,1.2354312E-3
 INDA15      1
 ATAB15      -1.725E-2,-1.45E-2
 INDA16      1
 ATAB16      1.25E-4,5.0E-5
 INDA51      1
 ATAB51      7.3510484E-3,1.7.27972E-3
 INDA52      1
 ATAB52      -5.2147852E-4,1.02389288E-3
 INDA53      1
 ATAB53      -3.1368631E-4,1.8.65268E-5
 INDA56      1
 ATAB56      8.7E-3,7.3418182E-3
 INDA57      1
 ATAB57      2.0E-5,3.6363636E-5
 REM     BCD 3ENGINE THRUST DATA
 INDTFF      3
 INDTSO      1
 IT10X       4
 TTAB10      -2.,-1.5,-1.,-.5,0.,.5,1.,1.5,2.
 TTAB10      0.,.1,.2,.3                                        10
 TTAB10      0.,0.,0.,0.,0.                                     14
 TTAB10      0.,0.,0.,0.                                        19
 TTAB10      0.,0.,0.,0.,0.                                     23
 TTAB10      0.,0.,0.,0.                                        28
 TTAB10      0.,0.,0.,0.,0.                                     32
 TTAB10      0.,0.,0.,0.                                        37
 TTAB10      0.,0.,0.,0.,0.                                     41
 TTAB10      0.,0.,0.,0.                                        46
 IT10H       9
 REM     BCD 3LANDING GEAR DATA
 NSTRUT      3
 MASS        4.94..0.,27.19587,27.19587
 RX          35..833,-2.83867,-2.83867
 RY          0.,-8.3333,+8.3333
 RZ          1.91657,.5.9583,.5.9583
 THETAD      0.,0.,0.
 ERDEG       0.
 RGR         4.47
 NTIRES      2.,3.,3.
 RZERO       1.047917,1.13125,1.13125
 H           .554.07,.604167,.604167
 DELTAM      .198333,.1958333,.19583333
 RLT         1.5E+3
 IFO         1
 AI          1.32.4533E+5,3.8129286E+5,3.8129286E+5
 BI          1.2112257,1.412391,1.412391
 FTAB.2      2,0.,0.,1.5E+4,0.
 FTAB.3      6,0.,0.,.007,.336,.1,.336,.4,.336,1.,.336,1.0.,.336
 MOMENT      1.2,2.5,2.5
 MB          0.,0.,0.
 RF          5.40333,6.8792,6.8792
 VZ          0.
 PZERO       3528..,4032.,4032.
 VZERO       0.1614583,.4716435,.4716435
 ?           .1114166,.2673611,.2673611
```

```
INDC.1          1
NSMAIN          2
CTAB.1          0.,1.6667,1.,2.,3.
CTAB.1          136.781,136.781,443.92,443.92,443.92,443.92,443.92                   6
CTAB.1          443.92                                                               13
INDC.2          1
CTAB.2          0.,1.6667,1.,2.,3.
CTAB.2          136.781,136.781,4.23E+4,4.23E+4,4.23E+4,4.23E+4                      6
CTAB.2          4.23E+4,4.23E+4                                                      12
MUS             .1,.1,.1
ES              .001333,.0016667,.0016667
SB              1.333,1.6667,1.6667
REM       BCD 4FLEXIBLE AIRFRAME DATA
INDFLX          0
REM       BCD 3AUTOPILOT DATA
REM       BCD 3A. ENGINE DATA
INDAUT          1
IN              2
ZN              -.55,-.55
YN              -14.1667,14.1667
N               0.,0.
REM       BCD 3B. DRAG CHUTE DATA
ICS             0
CDCH            .244
SSH             1605.
XCH             -9.625
YCH             0.
ZCH             -2.41667
REM       BCD 5C. PHASE BEGIN-TERMINATE
ITO             0
HF              12.25
NF              0
XRF             0.
HRF             8.796
DELTAH          3.
NLRI            0
TI              0.
KP              0
VS              10.
XS              3000.
TS              12.
HS              0.
REM       BCD 4G. HOLD MANEUVER DATA
ALPDES          11.5
TTD             0.
KE        INT 1,1
SM              11.5
REM       BCD 5H. LANDING ROLL MANEUVER DATA
TSP             0.
TRV             0.
TCH             7.
TBK             0.
ISS             0.
ILR             0
IBS             0
REM       BCD 5I. ENGINE FAILURE STAGE DATA
IC        INT 0,0
XRF1            0.
IT1       INT 0,0
XRF2            0.
IT2       INT 0,0
H1              0.
IH1       INT 0,0
H2              0.
```

```
T 2       INT 0,0
5.I           0.
IHR1      INT 0,0
HR2           0.
IHR2      INT 0,0
TR1           0.
ITR1      INT 0,0
TR2           0.
ITR2      INT 0
REM       BCD 5J. BRAKE COND.STAGE DATA
IB        INT 0,0,0
TBK1          1.
IBK1      INT 0,0,0
TBK2          1.
IBK2      INT 0,0,0
REM       BCD 4K. PITCH AUTOPILOT DATA
TST           .2
ALPDL         2.
RFALPH        0.
DELALA        .01
PSH           0.
PSH2          0.
RFALP2        0.
DELQF         8.
DELQTO        0.
DELQL         -10.
DELQU         +25.
DELFD1        5.25
REM       BCD 4L. YAW AUTOPILOT DATA
RFB           .5
DELBA         .05
PSR           10.
DPSIA         .05
RFPSI         .5
PSPSI         0.
DELRL         -20.
DELRU         +20.
REM       BCD 4M. ROLL AUTOPILOT DATA
RFPHI         .5
DPHIA         .05
PSA           -10.
DELPL         -12.
DELPU         +12.
REM       BCD 5N.THROTTLE AUTOPILOT DATA
TF        INT 0,0
NDF           0.,0.
IR        INT 0,0
NB            1.,1.
NLR           0.,0.
NTO           0.,0.
K2            1.
REM       BCD 4O. BRAKE AUTOPILOT DATA
MBC           0.,0.,0.
PD            .1
DELTAW        .001
OMEGD1        20.
MBL           0.,0.,0.
MBU           0.,0.,0.
REM       BCD 5P. CONTROL RESPONSE DATA
DELHS         5.25
DELRRD        31.5
DELA          10.
NED1          .1
REM       BCD 4Q. INITIALIZATION
T*P           3
```

```
 DELQD      4.50478
 DELQDE     4.50478
 DELQN      4.50478
 DELPU      0.
 DELRU      0.
 MANLOG     1
 PITCHP     1
 REM    BCD 3DATA PLOT TAPE
 IPLT       0
 REM    BCD 2STAGING DATA
 REM    BCD 4A.GEARS INTO PROGRAM
 INDLG      0
 ISTAGE     0
 DECRES BCD 1HR
 STESTD     11.0
        TRA
 INDLG      -1
 REM    BCD 4B.SMOOTH IMPACT STAGE
 AINCRS BCD 3DDELT1DDELT2DDELT3
 STEST      -.05,-.05,-.05
        TRA
 PRINT      .02
 DELTS      .005
 AMAXER     .0005
 PRTMIN     0.
 AINCRS BCD 1TIMES
 STEST      .9
        TRA
 ATAB51     7.3506484E-3,0.7027972E-3
 ATAB52     -5.2147652E-4,1.0258928E-3
 ATAB53     -3.1358651E-4,1.8065268E-5
 ATAB56     0.,0.
 ATAB57     0.,0.
 REM    BCD 5C. EFFICIENT AMAXER STAGE
 AINCRS BCD 4DELTA1DELTA2DELTA3
 STEST      .1,.1,.1
        TRA
 PRINT      .05
 AMAXER     .01
 DELTS      .01
 REM    BCD 4D.SMOOTH IMPACT STAGE
 AINCRS BCD 1DDELT1
 STEST      -.05
        TRA
 PRINT      .02
 DELTS      .005
 AMAXER     .0005
 REM    BCD 5E. EFFICIENT AMAXER STAGE
 AINCRS BCD 1DELTA1
 STEST      .1
        TRA
 PRINT      .05
 AMAXER     .01
 DELTS      .01
 INDSTF     1
        TRA
```

```
                      SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                             GENERALIZED COMPUTER PROGRAM

             INDSOF  2     CASE LROLL       STAGE  1     PAGE      8

      2SDF

 0.             0.             0.                             10.0000000E+00 29.0274042E+01  0.              59.0569126E+00
 0.             0.             0.             26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00  0.                            0.            -11.6059853E-01  0.              10.3393988E+00
 0.             0.            57.7454851E-01  0.            -31.6515539E+00 12.4671000E+04  0.               0.
 0.             0.

      VPCS

38.7489900E+02

      TFFS

 0.             0.

                                                              T(I)
                0.                  0.

      SAC1

29.7745819E-03-20.8749533E-03 60.9750569E-02  0.              0.             15.3281670E-03  0.

                                                              FLARE
    AUTS
    ALPDES          PHIDES          TTD

11.5000000E+00  0.               0.

                                                        PITCH AUTOPILOT

    DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

26.8544760E-01-14.0024531E-07  0.               0.             -14.0024531E-07 26.8544760E-01

INTEG RTN.     HT =   1.0000000E-03

      2SDF

 0.             0.             0.             0.              10.0000000E+00 29.0274042E+01  0.              59.0569126E+00
 0.             0.             0.             26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00  0.             0.              0.            -11.6059853E-01  0.              10.3393988E+00
 0.             0.            90.1422983E-02  0.            -26.3302709E+00 12.4671000E+04  0.               0.
 0.             0.

      VPCS

38.7489900E+02
```

E-7

ORIGINAL PAGE IS
OF POOR QUALITY

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 9

TFFS

0. 0.

T(I)

0. 0.

SAC1

29.7745819E-03-20.8749533E-03 60.9750569E-02 0. 0. 15.3281670E-03 0.

FLARE

AUTS

ALPDES PHIDES TTD

11.50000000E+00 0. 0.

PITCH AUTOPILOT

DELON ALPHAE ALPHD1 ALPDD1 ALPHET DELODE

27.5607208E-01-14.0024531E-07 0. 0. -14.0024531E-07 27.5607208E-01

STAGE ON--DECR. HR

E-8

```
INDLG       -1
REM     BCD 48.SMOOTH IMPACT STAGE
AINCRS  BCD 300ELT100ELT200ELT3
STEST       -.05,-.05,-.05
        TRA

  2SDF

 0.              0.              0.                          0.              10.0000000E+00  29.0274042E+01  0.              59.0569126E+00
 0.              0.              0.              26.5337670E-02  29.6220760E+01  10.4252977E+01  29.6159990E+01  0.
59.9992281E-01  11.4999986E+00   0.              0.               0.             -11.6059853E-01  0.              10.3393988E+00
 0.              0.              90.1422983E-02  0.             -26.3302709E+00  12.4671000E+04  0.               0.
 0.              0.

  LGEAR

  DELTA          P               P2              FT              SR              SF              AA              FC2

 0.              35.2800000E+03  0.              0.              31.9713310E-01-38.9549765E+02-78.8562277E+01  0.
 0.              40.3200000E+03  0.              0.              54.9315280E-01-10.7799996E+03-39.6383699E+01  0.
 0.              40.3230000E+03  0.              0.              54.9315280E-01-10.7799996E+03-39.6383699E+01  0.

  MUVP           VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

33.6000000E-02  29.6159990E+01  0.              0.              -0.             0.              0.              -79.6895154E-01
33.6000000E-02  29.6159990E+01  0.              0.              -0.             0.              0.              -10.9046626E-01
33.6000000E-02  29.6159990E+01  0.              0.              -0.             0.              0.              -10.9046626E-01

  SD2            SD1             S               S2D2            S2D1            S2              OMETD1          OMET

 0.              0.              0.              0.              0.              0.              0.              0.
 0.              0.              0.              0.              0.              0.              0.              0.
 0.              0.              0.              0.              0.              0.              0.              0.

  FTRA           FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

 0.              0.              0.              0.              0.              0.              0.              0.

  FZM            LM              MM              NM

 0.              0.              0.              0.

    VPCS

38.7489900E+02

    TFFS

 0.              0.
```

```
                                  SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM

                       INDSDF  2      CASE LROLL        STAGE  1      PAGE      11

                                                            T(I)
             0.                     0.
   SAC1
29.7745819E-03-20.8749533E-03 60.9750569E-02  0.           0.            15.3281670E-03  0.

                                                            FLARE
   AUTS
   ALPDES           PHIDES           TTD
11.5300000E+00  0.               0.

                                                    PITCH AUTOPILOT
   DELON            ALPHAE           ALPHD1           ALPOD1           ALPHET           DELQDE
27.5339224E-01-14.0024531E-07  0.                 0.             -14.0024531E-07 27.5339224E-01
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
INTEG RTN.      HT =   1.00000000E-03
```

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                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                     INDSDF  2      CASE LROLL        STAGE  1      PAGE      12

INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03
INTEG RTN.        HT =  1.0000000E-03

     2SDF

 50.0000000E-03 50.0000000E-03 14.8031852E+00  0.                 96.9255670E-01 29.0027316E+01  0.              59.3319920E+00
  0.            27.2368959E-04  0.            26.5170101E-02 29.6034000E+01 10.4122497E+01 29.5967086E+01  0.
 62.9389922E-01 11.5616902E+00  0.            12.6453882E-01  0.            -12.1824188E-01  0.              10.3434483E+00
  0.             0.            94.7824236E-02  0.            -26.7931133E+00 12.4671000E+04  0.               0.
  0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

  0.            35.2800000E+03  0.             0.            31.6148848E-01-38.9549765E+02-78.8562277E+01  0.
  0.            40.3200000E+03  0.             0.            49.9529874E-01-10.7799996E+03-39.6383699E+01  0.
  0.            40.3200000E+03  0.             0.            49.9529874E-01-10.7799996E+03-39.6383699E+01  0.

     HUVP           VGPT           FTRX           FTRY           FTRZ           HA             HB             DDELTA

 33.6000000E-02 29.5969757E+01  0.             0.            -0.             0.             0.            -76.6404145E-01
 33.6000000E-02 29.5988272E+01  0.             0.            -0.             0.             0.            -78.2919333E-02
 33.6000000E-02 29.5988272E+01  0.             0.            -0.             0.             0.            -78.2919333E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.             0.             0.             0.             0.             0.             0.             0.
  0.             0.             0.             0.             0.             0.             0.             0.
  0.             0.             0.             0.             0.             0.             0.             0.

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM
```

```
0.           0.           0.           0.           0.           0.           0.           0.
     FZM          LM           MM           NM
0.           0.           0.           0.
     VPCS
38.7489900E+02
     TFFS
0.           0.

                    0.                0.                            T(I)

     SAC1
30.0142493E-03-21.9770289E-03 62.1246500E-32  0.        0.        12.2577406E-03  0.

                                                        FLARE
   AUTS
   ALPDES        PHIDES        TTD
11.5000000E+03  0.            0.
                                                  PITCH AUTOPILOT
   DELON         ALPHAE        ALPHD1        ALPDD1        ALPHET        DELQDE
28.3036950E-01 61.6902417E-03 12.6453882E-01  0.           61.6902417E-03 28.3036950E-01
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
INTEG RTN.      HT =   1.[illegible]E-03
```

```
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03
INTEG RTN.          HT =  1.0000000E-03

     2SDF

10.0000000E-02 10.0000000E-02 29.5966730E+00 0.                  93.7100927E-01 28.9775565E+01 0.             59.6180378E+00
0.             48.1984450E-04 0.             26.5000399E-02 29.5844872E+01 10.3990476E+01 29.5772046E+01 0.
65.6393767E-01 11.6257361E+00 0.             12.9189599E-01 0.             -12.7133084E-01 0.             10.3544050E+00
0.             0.             99.5793099E-02 0.             -27.2603123E+00 12.4671000E+04 0.             0.
0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

0.             35.2800000E+03 0.             0.             31.1804704E-01-38.9549765E+02-78.8562277E+01 0.
0.             40.3200000E+03 0.             0.             44.7098906E-01-10.7799996E+03-39.6383699E+01 0.
0.             40.3200000E+03 0.             0.             44.7098906E-01-10.7799996E+03-39.6383699E+01 0.
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 15

MUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	29.5776739E+01	0.	0.	-0.	0.	0.	-73.4934807E-01
33.6000000E-02	29.5809538E+01	0.	0.	-0.	0.	0.	-46.1091723E-02
33.6000000E-02	29.5809538E+01	0.	0.	-0.	0.	0.	-46.1091723E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
0.	0.	0.	0.	0.	0.	0.	0.

FZM	LM	MM	NM
0.	0.	0.	0.

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

30.2764715E-03 -23.1185661E-03 63.3346129E-02 0. 0. 90.5478627E-04 0.

FLARE

AUTS

ALPDES	PHIDES	TTD
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
29.1245546E-01	12.5736266E-02	12.9189599E-01	0.	12.5736266E-02	29.1245546E-01

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                  GENERALIZED COMPUTER PROGRAM

                       INDSOF  2      CASE LROLL          STAGE  1      PAGE      52

 30.2996470E-01 21.1198847E-02-77.1641871E-01  0.               21.1198847E-02 42.3746470E-01

INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03

       2SDF

 62.1500000E-02 62.1500000E-02 18.2926421E+01  0.               72.9106618E-01 28.8828077E+01  0.                47.5733457E+00
  0.           -56.3926132E-03  0.            26.2199268E-02 29.2719799E+01 10.1811329E+01 29.2715415E+01  0.
-16.0212887E-01 93.5330334E-01  0.           -63.7143672E-01  0.             31.3595826E-02  0.             96.6689606E-01
  0.             0.            61.8985338E-01  0.           -47.8492989E+00 12.4671000E+04  0.              0.
  0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

  0.            35.2900000E+03  0.             0.           -14.8347490E+00-38.9549765E+02-78.8562277E+01  0.
 11.6694853E-02 27.4996217E+04  0.            53.8849378E+03-16.2392380E+00-52.8120637E+03 39.4498903E+00 19.5666741E+03
 11.6694853E-02 27.4996217E+04  0.            53.8849378E+03-16.2392380E+00-52.8120637E+03 39.4498903E+00 19.5666741E+03

     MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 33.6000000E-02 29.2636254E+01  0.             0.            -0.             0.             0.            -48.3938674E-01
 40.5994359E-03 24.7382237E-02 22.3466355E+02  0.           -55.0417389E+03 22.6718941E+02  0.             11.6694853E-02
 40.5994359E-03 24.7382237E-02 22.3466355E+02  0.           -55.0417389E+03 22.6718941E+02  0.             11.6694853E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.             0.             0.             0.             0.             0.             0.             0.
-85.0649783E-01-68.0124347E-02 15.0542108E-01  0.             0.             0.            29.0665309E+01-28.8523553E+01
-85.0649783E-01-68.0124347E-02 15.0542108E-01  0.             0.             0.            29.0665309E+01-28.8523553E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

 22.8910655E+03  0.           -10.7769876E+04  0.           -16.6712311E+04  0.            22.8910655E+03  0.

     FZM            LM             MM             NM

-10.8232559E+04  0.           -16.8025716E+04  0.

       VPCS

 38.7489900E+02

       TFFS

  0.             0.
```


ORIGINAL PAGE IS
OF POOR QUALITY

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2   CASE LROLL   STAGE 1   PAGE 53

```
                                                              T(I)
                 0.                 0.
    SAC1
32.1641259E-03-66.0010496E-04 47.2288173E-02  0.            0.            17.6446850E-03  0.

                                                          LANDING ROLL
                                  ISS =  1          ILR = 1          IOS = 0          IBS = 1
    AUTS
    TI              TR
17.1500000E-02 45.0000000E-02
                                                        PITCH AUTOPILOT
    DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE
30.2996471E-01 21.1198847E-02-63.7143672E-01  0.                21.1198847E-02 43.4246470E-01
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
    2SDF
64.1500000E-02 64.1500000E-02 18.8780351E+01  0.                73.2578161E-01 28.8885384E+01  0.                46.9996324E+00
 0.           -56.7441972E-03  0.           26.2166936E-02 29.2683670E+01 10.1786094E+01 29.2677849E+01  0.
-18.4582715E-01 92.4066002E-01  0.          -48.9187614E-01  0.            36.1341828E-02  0.                96.0200168E-01
 0.             0.            49.4226101E-01  0.           -40.2846841E+00 12.4671000E+04  0.                 0.
 0.             0.
    LGEAR
    DELTA           P               P2              FT              SR              SF              AA              FC2
 0.             35.2800000E+03  0.             0.           -85.8816724E-01-38.9549765E+02-78.8562277E+01  0.
94.8780104E-03 25.9745872E+04  0.           40.1335917E+03-85.6141224E-01-39.2203802E+03 33.5790523E+00 29.3150118E+03
94.8780104E-03 25.9745872E+04  0.           40.1335917E+03-85.6141224E-01-39.2203802E+03 33.5790523E+00 29.3150118E+03
    HUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA
33.6000000E-02 29.2595892E+01  0.             0.           -0.             0.              0.             -48.3354383E-01
55.5735113E-03 33.8604567E-02 22.8352421E+02  0.           -41.0901553E+03 23.6658053E+02  0.              94.8780104E-03
55.5735113E-03 33.8604567E-02 22.8352421E+02  0.           -41.0901553E+03 23.6658053E+02  0.              94.8780104E-03
    SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                    INDSUF  2      CASE LROLL        STAGE  1      PAGE      54

 0.             0.            0.            0.              0.            0.              0.            0.
-67.0563894E-01-83.2482002E-02 14.9023518E-01  0.           0.            0.             30.3437760E+01-28.2522521E+01
-67.0563894E-01-83.2482002E-02 14.9023518E-01  0.           0.            0.             30.3437760E+01-28.2522521E+01
     FTRA           FTRB           FTRC           HTX           HTY           HTZ           FXM           FYM
 18.2110333E+03  0.          -80.2671834E+03  0.          -11.5700411E+04  0.            18.2110333E+03  0.
     FZM            LM             MM             NM
-80.6319131E+03  0.          -11.6735758E+04  0.
     VPCS
 38.7489900E+02
     TFFS
  0.             0.

                                                               T(I)
                 0.            0.
     SAC1
 32.1313174E-03-57.5249362E-04 46.1927622E-02  0.              0.           19.1075466E-03  0.
                                                         LANDING ROLL
                         ISS =  1          ILR = 1              ICS = 0          IBS = 1
   AUTS
   TI             TR
 17.1500000E-02 47.0000000E-02
                                                      PITCH AUTOPILOT
   DELON          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELODE
 30.2996475E-01 21.1198847E-02-48.9187814E-01  0.           21.1198847E-02 44.4746470E-01
INTEG RTN.     HT =  1.0000000E-03
INTEG RTN.     HT =  1.0000000E-03
INTEG RTN.     HT =  1.0000000E-03
INTEG RTN.     HT =  1.0000000E-03
     2SDF
 66.1500000E-02 66.1500000E-02 19.4633538E+01  0.           73.6387960E-01 28.8917405E+01  0.           46.5732413E+00
```

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                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                        GENERALIZED COMPUTER PROGRAM

                             INDSOF  2      CASE LROLL        STAGE  1      PAGE     55

  0.                -56.3808266E-03  0.                26.2134227E-02 29.2647115E+01 10.1760557E+01 29.2640683E+01  0.
-19.4021516E-01 91.5725565E-01  0.                -34.7744374E-01  0.              37.9867845E-02  0.            95.3712275E-01
  0.               0.                36.7432276E-01  0.               -33.2755916E+00 12.4671000E+04  0.             0.
  0.               0.

    LGEAR

    DELTA           P               P2              FT              SR              SF              AA              FC2

  0.             35.2800000E+03  0.              0.              -27.3834214E-01-38.9549765E+02-78.8562277E+01  0.
72.3434285E-03 24.3836493E+04  0.              27.2805706E+03-14.5194675E-01-26.5397426E+03 28.3435693E+00 38.0122258E+03
72.3434285E-03 24.3836493E+04  0.              27.2805706E+03-14.5194675E-01-26.5397426E+03 28.3435693E+00 38.0122258E+03

    HUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

33.6600000E-02 29.2556964E+01  0.              0.              -0.              0.              0.             -48.3107499E-01
74.6606221E-03 45.4873368E-02 20.9156627E+02  0.              -28.0143162E+03 22.1477955E+02  0.              72.3404285E-03
74.6606221E-03 45.4873368E-02 20.9156627E+02  0.              -28.0143162E+03 22.1477955E+02  0.              72.3404285E-03

    SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

  0.              0.              0.              0.              0.              0.              0.              0.
-48.3768316E-01-94.7963164E-02 14.7236858E-01  0.              0.              0.              28.3946096E+01-27.6602601E+01
-48.3768316E-01-94.7963164E-02 14.7236858E-01  0.              0.              0.              28.3946096E+01-27.6602601E+01

    FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

13.4085088E+03  0.             -54.5611413E+03  0.              -71.1212210E+03  0.              13.4085388E+03  0.

    FZM             LM              HM              NM

-54.8242713E+03  0.             -71.8681603E+03  0.

      VPCS

38.7489900E+02

      TFFS

  0.              0.

                                                                 T(I)
                  0.               0.

      SAC1

32.0946873E-03-50.7649659E-04 45.3767937E-02  0.              0.              20.4410987E-03  0.

                                                          LANDING ROLL
                          ISS =  1          ILR = 1           ICS = 0           IBS = 1
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                             GENERALIZED COMPUTER PROGRAM
                 INOSDF  2     CASE LROLL        STAGE  1     PAGE     56
     AUTS
     TI              TR
17.1500000E-02 49.0000000E-02
                                                             PITCH AUTOPILOT
     DELON          ALPHAE          ALPHD1          ALPDD1          ALPHET          DELODE
30.2996470E-01 21.1198847E-02-34.7744374E-01  0.               21.1198847E-02 45.5246470E-01
INTEG RTN.     HT =   1.0000000E-03
INTEG RTN.     HT =   1.0000000E-03
INTEG RTN.     HT =   1.0000000E-03
INTEG RTN.     HT =   1.0000000E-03
      2SDF
 68.1500000E-02 68.1500000E-02 2[illegible].485966E+01  0.               74.0251567E-01 28.8924877E+01  0.               46.2794317E+00
  0.           -55.4197887E-03  0.              26.2099116E-02 29.2607878E+01 10.1733157E+01 29.2601685E+01  0.
-19.0381842E-01 91.0022514E-01  0.             -22.7281121E-01  0.             37.2791837E-02  0.               94.7301595E-01
  0.             0.             25.3955726E-01  0.             -27.5096971E+00 12.4671000E+04  0.                0.
  0.             0.
     LGEAR
     DELTA          P               P2              FT              SR              SF              AA              FC2
  0.            35.2800000E+03  0.               0.              21.1173600E-01-38.9549765E+02-78.8562277E+01  0.
51.2003347E-03 22.8333476E+04  0.              16.6723350E+03 43.9454560E-01-16.0115882E+03 24.2958507E+00 44.5810024E+03
51.2003347E-03 22.8333476E+04  0.              16.6723350E+03 43.9454560E-01-16.0115882E+03 24.2958507E+00 44.5810024E+03
     HUVP           VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA
33.6000000E-02 29.2517171E+01  0.               0.              -0.              0.              0.             -48.2962890E-01
10.1372763E-02 61.7571865E-02 17.4296928E+02  0.             -17.1936644E+03 18.8249339E+02  0.               51.2003347E-03
10.1372763E-02 61.7571865E-02 17.4296928E+02  0.             -17.1936644E+03 18.8249339E+02  0.               51.2003347E-03
     SD2            SD1             S               S2D2            S2D1            S2              OMETD1          OMET
  0.             0.              0.              0.              0.              0.              0.              0.
-30.4485408E-01-10.2660821E-01 14.5256316E-01  0.               0.              0.             24.1345306E+01-27.1318846E+01
-30.4485408E-01-10.2660821E-01 14.5256316E-01  0.               0.              0.             24.1345306E+01-27.1318846E+01
     FTRA           FTRB            FTRC            MTX             MTY             MTZ             FXH             FYH
90.9797430E+02  0.             -33.3446700E+03  0.             -36.8819522E+03  0.              90.9797430E+02  0.
     FZH            LH              MH              NH
```

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OF POOR QUALITY

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                       SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                           GENERALIZED COMPUTER PROGRAM
            INDSOF  2     CASE LROLL       STAGE  1     PAGE     57
-33.5102850E+03  0.          -37.3520783E+03  0.
     VPCS
38.7489900E+02
     TFFS
 0.              0.

                                               T(I)
                 0.               0.
     SAC1
32.0569960E-03-45.4768223E-04 44.7596670E-02  0.           0.            21.6569792E-03  0.

                                             LANDING ROLL
                              ISS =  1          ILR = 1          ICS = 0          IBS = 1
    AUTS
    TI               TR
17.1500000E-02 51.0000000E-02

                                             PITCH AUTOPILOT
    DELQN            ALPHAE           ALPHD1           ALPDD1           ALPHET           DELQDE
30.2996470E-01 21.1198847E-02-22.7281121E-01  0.              21.1198847E-02 46.5746470E-01

INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
     2SDF
70.1500000E-02 70.1510000E-02 20.6337583E+01  0.              74.3935200E-01 28.8911102E+01  0.              56.8925942E+00
 0.           -54.3159400E-03  0.           26.2960547E-02 29.2564783E+01 10.1703083E+01 29.2559456E+01  0.
-17.6551425E-01 90.6452216E-01  0.         -13.5075249E-01  0.            34.5760876E-02  0.             94.1828191E-01
 0.              0.            16.2516449E-01  0.           -23.3045572E+00 12.4671000E+04  0.              0.
 0.              0.
     LGEAR
    DELTA            P                P2               FT               SR               SF               AA               FC2
 0.             35.2830000E+03  0.               0.             56.7422524E-01-38.9549765E+02-78.8562277E+01  0.
33.1126455E-03 21.3892458E+04  0.            19.5115729E+02 86.5603277E-01-83.6305250E+02 21.6247831E+00 48.5423373E+03
```

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                  GENERALIZED COMPUTER PROGRAM

                   INDSDF  2      CASE LROLL        STAGE  1      PAGE      58

33.1126455E-03 21.3892458E+04  0.            89.5115729E+02 86.5803277E-01-83.6305250E+02 21.6247831E+00 48.5423373E+03
     HUVP          VGP1            FTRX            FTRY           FTRZ           MA             MB            DDELTA

33.63000000E-02 29.2474972E+01  0.             0.             -0.             0.             0.           -48.2724322E-01
14.1031851E-02 85.8913106E-02 13.0995814E+02  0.             -92.9036130E+02 14.3851396E+02  0.            33.1126455E-03
14.1031851E-02 85.8913106E-02 13.0995814E+02  0.             -92.9036130E+02 14.3851396E+02  0.            33.1126455E-03
     SD2            SD1             S              S2D2           S2D1           S2            OMETD1          OMET

  0.             0.             0.             0.             0.             0.             0.             0.
-14.5821334E-01-10.7124833E-01 14.3153172E-01  0.             0.             0.            18.4424867E+01-26.7044031E+01
-14.5821334E-01-10.7124833E-01 14.3153172E-01  0.             0.             0.            18.4424867E+01-26.7044031E+01
     FTRA           FTRB            FTRC           MTX            MTY            MTZ            FXM            FYM

56.2266358E+02  0.            -17.9023146E+03  0.            -14.4461157E+03  0.            56.2266358E+02  0.
     FZM            LM              MM             NM

-17.9816293E+03  0.            -14.6712641E+03  0.
      VPCS

38.7489900E+02
      TFFS

  0.             0.

                                                         T(I)
                 0.             0.

      SAG1

32.0236535E-03-41.3324883E-04 44.3342398E-02  0.             0.             22.7760654E-03  0.

                                                     LANDING ROLL
                          ISS =  1        ILR = 1              ICS = 0          IBS = 1
     AUTS
     TI             TR

17.1500000E-02 53.0000000E-02

                                                     PITCH AUTOPILOT

     DELON          ALPHAE          ALPHD1         ALPDD1         ALPHET         DELQDE

30.2996470E-01 21.1198847E-02-13.5079249E-01  0.             21.1198847E-02 47.6246470E-01
```

```
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
        2SDF

 72.1530000E-02 72.1530000E-02 21.2188318E+01  0.                74.7265955E-01 28.8880558E+01  0.               45.9834023E+00
  0.           -52.3063913E-03  0.                26.2518167E-02 29.2517436E+01 10.1670069E+01 29.2513291E+01  0.
-15.5714373E-01 90.4434425E-01  0.               -71.6214438E-02  0.             30.5002028E-02  0.               93.4934550E-01
  0.              0.            95.4568260E-02  0.               -20.6364372E+00 12.4671000E+04  0.                0.
  0.              0.

      LGEAR

      DELTA           P              P2              FT              SR              SF              AA              FC2

  0.            35.2830000E+03  0.              0.              79.6181651E-01-38.9549765E+02-78.8562277E+01  0.
 19.1875430E-03 20.0831828E+04  0.              41.0326337E+02 11.3638999E+00-35.5363599E+02 20.2026038E+00 49.9870374E+03
 19.1875430E-03 20.0831828E+04  0.              41.0326337E+02 11.3638999E+00-35.5363599E+02 20.2026038E+00 49.9870374E+03

      HUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 33.6030000E-02 29.2429461E+01  0.              0.              -0.              0.              0.             -48.2246445E-01
 19.8305116E-02 12.0783119E-01 85.2443556E+01  0.             -42.9864848E+02 94.7971475E+01  0.              19.1875430E-03
 19.8305016E-02 12.0783119E-01 85.2443556E+01  0.             -42.9864848E+02 94.7971475E+01  0.              19.1875430E-03

      SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

  0.              0.              0.              0.              0.              0.              0.              0.
-18.0102415E-02-10.8707251E-01 14.0990592E-01  0.              0.              0.             12.1534676E+01-26.3982494E+01
-18.0102415E-02-10.8707251E-01 14.0990592E-01  0.              0.              0.             12.1534676E+01-26.3982494E+01

      FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

 30.7890223E+02  0.             -82.0612675E+02  0.             -29.9016688E+02  0.              30.7890223E+02  0.

      FZM             LM              MM              NM

-82.1592283E+02  0.             -30.1797473E+02  0.

        VPCS

 38.7489900E+02

        TFFS

  0.              0.
```

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
              INDSDF  2      CASE LROLL        STAGE  1      PAGE      60
                                                        T(I)
          0.                    0.
    SAG1
31.9874616E-03-37.9918838E-04 43.9679670E-02  0.             0.            23.8223836E-03  0.
                                                    LANDING ROLL
                              ISS =  1          ILR = 1          ICS = 0          IBS = 1
   AUTS
   TI              TR
17.1500000E-02 55.0000000E-02
                                                    PITCH AUTOPILOT
   DELQN           ALPHAE          ALPHO1          ALPDD1          ALPHET          DELQDE
30.2996470E-01 21.1198847E-02-71.6214438E-02  0.            21.1198847E-02 48.6746470E-01
INTEG RTN.     HT =   1.0000000E-03
INTEG RTN.     HT =   1.0000000E-03
INTEG RTN.     HT =   1.0000000E-03
INTEG RTN.     HT =   1.0000000E-03
    2SDF
 74.1500000E-02 74.1500000E-02 21.8038689E+01  0.            75.0136348E-01 28.8837917E+01  0.            45.9248716E+00
  0.           -50.4326355E-03  0.            26.1972235E-02 29.2460129E+01 10.1634321E+01 29.2463206E+01  0.
-13.0744330E-01 90.3433349E-01  0.           -32.3204096E-02  0.            25.6136204E-02  0.            92.9046934E-01
  0.             0.            52.1939216E-02  0.           -19.2304008E+00 12.4671000E+04  0.             0.
  0.             0.
   LGEAR
   DELTA           P               P2              FT              SR              SF              AA              FC2
 0.             55.2800000E+03  0.              0.            91.5083186E-01-38.9549765E+02-78.8562277E+01  0.
10.0360845E-03 18.9231636E+04  0.            16.2546709E+02 12.7926022E+00-10.9025040E+02 19.6800726E+00 49.4304800E+03
10.0360845E-03 18.9231636E+04  0.            16.2546709E+02 12.7926022E+00-10.9025040E+02 19.6800726E+00 49.4304800E+03
   HUVP            VGPT            FTRX            FTRY            FTRZ            HA              HB              DDELTA
33.6000000E-02 29.2385042E+01  0.             0.            -0.              0.              0.           -48.1435182E-01
26.2940182E-02 16.0133227E-01 45.2561406E+01  0.           -17.2110490E+02 50.7418146E+01  0.            10.0360845E-03
26.2948182E-02 16.0133227E-01 45.2561406E+01  0.           -17.2110490E+02 50.7418146E+01  0.            10.0360845E-03
   SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET
```

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                 INDSOF  2      CASE LROLL        STAGE  1     PAGE      61

 0.            0.              0.              0.              0.              0.              0.              0.
72.0714580E-02-10.8100382E-01 13.8819516E-01  0.              0.              0.              65.0536384E+00-26.2142026E+01
72.0714580E-02-10.8100382E-01 13.8819516E-01  0.              0.              0.              65.0536384E+00-26.2142026E+01
     FTRA          FTRB            FTRC           HTX             HTY            HTZ             FXM            FYM

14.4895913E+02  0.            -32.5093419E+02  0.             48.1113508E+01  0.             14.4895913E+02  0.
     FZM           LM              MM             NM

-32.1173327E+02  0.            59.2391984E+01  0.
     VPCS

38.7489900E+02
     TFFS

 0.             0.

                                                             T(I)
              0.              0.
     SAC1

31.9586005E-03-35.1576610E-04 43.7115696E-02  0.             0.             24.8181620E-03  0.

                                                       LANDING ROLL
                                ISS =  1        ILR = 1         IDS = 0         IBS = 1
    AUTS
     TI            TR

17.1500000E-02 57.0000000E-02

                                                       PITCH AUTOPILOT

     DELON         ALPHAE         ALPHD1         ALPDD1          ALPHET         DELQDE

30.2996470E-01 21.1198847E-02-32.3204096E-02  0.             21.1198847E-02 49.7246470E-01
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INOSOF 2 CASE LROLL STAGE 1 PAGE 144

```
INTEG RTN.    HT =  1.0000000E-03
INTEG RTN.    HT =  1.0000000E-03
INTEG RTN.    HT =  1.0000000E-03
INTEG RTN.    HT =  1.0000000E-03

      2SDF

 20.5675000E-01 20.5675000E-01 60.0776061E+01  0.                   69.9552454E-01 28.9899038E+01  0.                   67.7620672E-01
  0.           -18.9920053E-02  0.             25.9743277E-02 28.9978222E+01 99.9140191E+00 28.9978171E+01  0.
 17.1763950E-02 13.3900880E-01  0.            -10.6071246E+00  0.            -33.9379901E-03  0.                   13.0507056E-01
  0.             0.            -13.7002696E-01  0.            -30.8253423E+00 12.4671000E+04  0.                    0.
  0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

 82.6003649E-03 57.7510129E+03  0.             12.9768983E+03-17.8521723E-01-12.8344942E+03 28.8267330E+00-69.5445122E+02
 12.5156996E-02 23.5831491E+04  0.             60.7423223E+03 15.6931204E-01-59.9173756E+03 30.7122598E+00 29.8851747E+02
 12.5156996E-02 23.5831491E+04  0.             60.7423223E+03 15.6931204E-01-59.9173756E+03 30.7122598E+00 29.8851747E+02

     MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 33.6010000E-02 15.2496459E+01-43.2823799E+02  0.            -12.8816607E+03-41.7812013E+02  0.             82.6003649E-03
 29.9322238E-04 18.0121342E-03 18.1874856E+01  0.            -60.7622265E+03 18.2983021E+01  0.             12.5156996E-02
 29.9322238E-04 18.0121342E-03 18.1874856E+01  0.            -60.7622265E+03 18.2983021E+01  0.             12.5156996E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-51.2513826E-01 66.5310695E-01 56.8969582E-02  0.             0.             0.            -17.4088339E+02-14.1077993E+01
 11.5917841E-02-26.5801676E-02 14.6246717E-01  0.             0.             0.             23.4593616E+00-28.7115329E+01
 11.5917841E-02-26.5801576E-02 14.6246717E-01  0.             0.             0.             23.4593616E+00-28.7115329E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

-90.2251954E+01  0.           -13.4461543E+04  0.             97.6890453E+03  0.            -90.2251954E+01  0.

     FZM            LM             MM             NM

-13.4480556E+04  0.             98.5151884E+03  0.

     VPCS

 38.7489930E+02

     TFFS

  0.             0.
```

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                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
                    INOSDF  2     CASE LROLL        STAGE  1      PAGE     145
                                                         T(I)
             0.                    0.
     SAC1
32.4484639E-03 27.4782202E-03-93.7615814E-03  0.             0.           67.2560821E-04  0.
                                                      LANDING ROLL
    AUTS                           ISS =  1          ILR = 1         ICS = 0          IBS = 1
    TI             TR
17.15000000E-02 18.85250000E-01
                                                      PITCH AUTOPILOT
    DELQN          ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE
30.2996470E-01 21.1198847E-02-16.6071246E+00  0.              21.1198847E-02 80.0000000E-01
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
     2SDF
28.7675000E-01 23.7675000E-01 60.6575211E+01  0.              69.9170297E-01 28.9879068E+01  0.             57.1445327E-01
 0.           -18.7974695E-02  0.            25.9704906E-02 28.9935388E+01 99.8845148E+00 28.9935314E+01  0.
20.6593048E-02 11.2933871E-01  0.           -10.3652437E+00  0.           -40.8259327E-03  0.             10.8851268E-01
 0.             0.          -16.4628314E-01  0.            -30.1634212E+00 12.4671000E+04  0.              0.
 0.             0.
    LGEAR
    DELTA          P               P2              FT              SR              SF              AA              FC2
87.5317049E-03 67.7614288E+03  0.             13.9047113E+03-18.5902022E-01-13.7686293E+03 27.5469678E+00-58.4866232E+02
12.3906426E-02 23.1798268E+04  0.             59.8933443E+03 22.9391545E-01-59.0595066E+03 30.6604545E+00 27.8828085E+02
12.3906426E-02 23.1798268E+04  0.             59.8933443E+03 22.9391545E-01-59.0595066E+03 30.6604545E+00 27.8828085E+02
    HUVP           VGPT            FTRX            FTRY            FTRZ            MA              HB              DDELTA
33.6500000E-02 11.8682083E+01-46.4318353E+02  0.             -13.8189986E+03-44.5924379E+02  0.             87.5317049E-03
20.4493257E-04 12.3043282E-03 12.2504716E+01  0.             -59.9064822E+03 12.3404339E+01  0.             12.3906426E-02
20.4493257E-04 12.3043282E-03 12.2504716E+01  0.             -59.9064822E+03 12.3404339E+01  0.             12.3906426E-02
    SD2            SD1             S               S2D2            S2D1            S2              OMETD1          OMET
```

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                  GENERALIZED COMPUTER PROGRAM
                      INDSOF  2      CASE LROLL        STAGE  1      PAGE    146

-64.8024632E-01 65.3906097E-01 70.1936113E-02  0.              0.              0.              -18.5801825E+02-17.7007412E+01
 78.5176072E-02-25.6742682E-02 14.5721938E-01  0.              0.              0.               15.8210691E+00-28.6722012E+01
 78.6176372E-02-25.6742682E-02 14.5721938E-01  0.              0.              0.               15.8210691E+00-28.6722012E+01
      FTRA           FTRB           FTRC           HTX             HTY             HTZ             FXM             FYM
-18.5877569E+02  0.           -13.3691400E+04  0.              12.9188881E+04  0.              -18.5877569E+02  0.
      FZM            LM             MM             NM
-13.3681651E+04  0.            13.0433368E+04  0.
        VPCS
 38.7489900E+02
        TFFS
  0.             0.

                                                                 T(I)
                 0.              0.
        SAC1
 32.4520715E-03 28.1970723E-03-10.4797977E-02  0.              0.              70.1003410E-04  0.
                                                              LANDING ROLL
                          ISS =  1          ILR = 1             ICS = 0            IBS = 1
      AUTS
      TI             TR
 17.1500000E-02 19.0525000E-01
                                                          PITCH AUTOPILOT
      DELQN          ALPHAE         ALPHO1         ALPOD1          ALPHET          DELQDE
 36.2996470E-01 21.1198847E-02-10.3652437E+00  0.              21.1198847E-02 80.0000000E-01
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
        2SDF
 20.9675000E-01 20.9675000E-01 61.2373452E+01  0.              69.8719245E-01 28.9851586E+01  0.              46.7573928E-01
  0.           -18.5549888E-02  0.              25.9663617E-02 28.9889297E+01 99.8527735E+00 28.9889188E+01  0.
```

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25.1659598E-02 92.4186398E-02  0.             -10.1550057E+00  0.            -49.7388831E-03  0.              87.4446601E-02
 0.             0.            -19.4536533E-01  0.             -29.7998813E+00 12.4671000E+04  0.               0.
 0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

94.2813891E-03 81.6268418E+03  0.             15.1957589E+03-24.5424104E-01-15.0713186E+03 25.1933505E+00-55.7346301E+02
12.3186150E-02 22.8129800E+04  0.             59.4372902E+03 27.3785850E-01-58.5682002E+03 30.8535809E+00 23.2753274E+02
12.3186150E-02 22.8129800E+04  0.             59.4372902E+03 27.3785850E-01-58.5682002E+03 30.8535809E+00 23.2753274E+02

     HUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6200000E-02 82.9859780E+00-50.8031569E+02  0.            -15.1199872E+03-48.4476843E+02  0.             94.2813891E-03
11.1524635E-04 67.0967849E-04 66.2626385E+00  0.            -59.4152210E+03 66.7969403E+00  0.             12.3186150E-02
11.1524635E-04 67.0967849E-04 66.2626085E+00  0.            -59.4152210E+03 66.7969403E+00  0.             12.3186150E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-94.3414351E-01 63.8336494E-01 83.0258169E-02  0.             0.             0.            -20.1865351E+02-21.5686502E+01
 14.2118644E-01-23.4572834E-02 14.5228504E-01  0.             0.             0.             85.6371029E-01-28.6479919E+01
 14.2118644E-01-23.4572834E-02 14.5228504E-01  0.             0.             0.             85.6371029E-01-28.6479919E+01

     FTRA           FTRG           FTRC           MTX            MTY            MTZ            FXM            FYM

-29.0294587E+02  0.            -13.4010339E+04  0.             17.0826895E+04  0.            -29.0294587E+02  0.

     FZM            LM             MM             NM

-13.3973643E+04  0.             17.2681372E+04  0.

     VPCS

38.7489900E+02

     TFFS

 0.             0.

                                                             T(I)
                0.             0.

     SAC1

82.4564369E-03 28.9220012E-03-11.5485887E-02  0.             0.             72.7188934E-04  0.

                                                     LANDING ROLL
                              ISS =  1          ILR = 1        IGS = 0          IBS = 1
     AUTS
```

```
                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                        GENERALIZED COMPUTER PROGRAM

                           INDSOF  2      CASE LROLL        STAGE  1      PAGE     148

        TI                  TR

 17.1500000E-02 19.2525000E-01

                                                                   PITCH AUTOPILCT

        DELQN               ALPHAE              ALPHO1              ALPDD1              ALPHET              DELQDE

 30.2996473E-01 21.1198847E-02-10.1550657E+00  0.                  21.1198847E-02 80.0000000E-01

INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03

         2SDF

 21.0975000E-01 21.0975000E-01 61.6141835E+01  0.                  69.8371474E-01 28.9829473E+01  0.                  40.1149358E-01
  0.           -16.3640306E-02  0.            25.9634893E-02 28.9857233E+01 99.8306962E+00 28.9857095E+01  0.
 28.3505670E-02 79.2973105E-02  0.           -10.0334087E+00  0.           -56.0393920E-03  0.                  73.6932823E-02
  0.             0.           -21.5743958E-01  0.                 -29.7357206E+00 12.4671000E+04  0.                  0.
  0.             0.

        LGEAR

        DELTA               P                   P2                  FT                  SR                  SF                  AA                  FC2

 10.0079198E-02 93.8139792E+03  0.                 16.3222778E+03-31.9724318E-01-16.2106409E+03 22.5985759E+00-53.2685612E+02
 12.2970190E-02 22.6214127E+04  0.                 59.2627903E+03 28.6897074E-01-58.4171234E+03 31.0954190E+00 19.3042667E+02
 12.2970190E-02 22.6214127E+04  0.                 59.2627903E+03 28.6897074E-01-58.4171234E+03 31.0954190E+00 19.3042667E+02

        HUVP                VGPT                FTRX                FTRY                FTRZ                MA                  MB                  DDELTA

 33.6000000E-02 58.5412251E+00-54.6113686E+02  0.                 -16.2533835E+03-51.7627032E+02  0.                 10.0079198E-02
 60.8743016E-05 36.6212833E-04 36.0790764E+00  0.                 -59.2681566E+03 36.3778043E+00  0.                 12.2970190E-02
 60.8743016E-05 36.6212833E-04 36.0790764E+00  0.                 -59.2681566E+03 36.3778043E+00  0.                 12.2970190E-02

        SD2                 SD1                 S                   S2D2                S2D1                S2                  OMETD1              OMET

-12.7700060E+00 62.4054610E-01 91.2360547E-02  0.                  0.                  0.                -21.5677930E+02-24.2791799E+01
 17.9305092E-01-21.3627162E-02 14.4936649E-01  0.                  0.                  0.                 46.6382106E-01-28.6394875E+01
 17.9305092E-01-21.3627162E-02 14.4936649E-01  0.                  0.                  0.                 46.6382106E-01-28.6394875E+01

        FTRA                FTRB                FTRC                MTX                 MTY                 MTZ                 FXM                 FYM

-36.5492862E+02  0.               -13.4847859E+04  0.                 20.6493632E+04  0.                -36.5492862E+02  0.

        FZM                 LH                  MH                  NM

-13.4813415E+04  0.                20.8983668E+04  0.
```

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VPCS

30.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.4603187E-03 29.3984428E-03-12.2264911E-02 0. 0. 74.3099679E-04 0.

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI TR

17.1500000E-02 19.3825000E-01

PITCH AUTOPILOT

DELON ALPHAE ALPHD1 ALPDD1 ALPHET DELQDE

30.2996479E-01 21.1198847E-02-10.0334387E+03 0. 21.1198847E-02 80.0000000E-01

STAGE ON--INCR. DELTA1

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 150

PRINT .05
AMAXER .01
DELTS .01
INDSTF 1
TRA

2SDF

21.0975000E-01	21.0975300E-01	61.6141835E+01	0.	69.8371474E-01	28.9829473E+01	0.	40.1149358E-01
0.	-18.3E4.9.6E-02	0.	25.9634893E-02	28.9857233E+01	99.8306962E+00	28.9857095E+01	0.
26.3535670E-02	79.2973135E-02	0.	-10.0334087E+00	0.	-56.0393920E-03	0.	73.6932823E-02
0.	0.	-21.5743958E-01	0.	-29.7357266E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
10.0079198E-02	93.8139792E+03	0.	16.3222778E+03	-31.9724318E-01	-16.2166409E+03	22.5985759E+00	-53.2685612E+02
12.2970190E-02	22.6014127E+04	0.	59.2627903E+03	28.6897074E-01	-58.4171234E+03	31.0954190E+00	19.3042667E+02
12.2970190E-02	22.6014127E+04	0.	59.2627903E+03	28.6897074E-01	-58.4171234E+03	31.0954190E+00	19.3042667E+02

HUVP	VGPT	FTRX	FTRY	FTRZ	HA	HB	DDELTA
33.6000000E-02	58.5412251E+03	-54.6113686E+02	0.	-16.2533835E+03	-51.7627032E+02	0.	10.0079198E-02
60.8743016E-05	36.6212833E-04	36.0790764E+00	0.	-59.2681566E+03	36.3778043E+00	0.	12.2970190E-02
60.8743016E-05	36.6212833E-04	36.0790764E+00	0.	-59.2681566E+03	36.3778043E+00	0.	12.2970190E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
-12.7735561E+00	62.4054610E-01	91.2363547E-02	0.	0.	0.	-21.5677930E+02	-24.2791799E+01
17.9335092E-01	-21.3627162E-02	14.4936649E-01	0.	0.	0.	46.6382106E-01	-28.6394875E+01
17.9335092E-01	-21.3627162E-02	14.4936649E-01	0.	0.	0.	46.6382106E-01	-28.6394875E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXH	FYH
-36.5492862E+02	0.	-13.4847859E+04	0.	20.6493632E+04	0.	-36.5492862E+02	0.

FZH	LM	MM	NM
-13.4813415E+04	0.	20.8983668E+04	0.

VPCS

38.7489900E+02

TFFS

0.	0.

```
                                SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                     GENERALIZED COMPUTER PROGRAM

                          INDSDF  2      CASE LROLL         STAGE  1       PAGE     151

                                                                       T(I)
                  0.                        0.

         SAC1

 32.4603187E-03 29.3980428E-03-12.2264911E-02  0.              0.              74.3099679E-04  0.

                                                              LANDING ROLL
       AUTS                               ISS =  1           ILR = 1          IGS = 0           IBS = 1

       TI              TR

 17.1500000E-02 19.3825000E-01

                                                         PITCH AUTOPILOT

       DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

 30.2996470E-01 21.1198847E-02-10.0334087E+00  0.              21.1198847E-02 80.0000000E-01

INTEG RTN.       HT =   8.0000000E-03
INTEG RTN.       HT =   8.0000000E-03
INTEG RTN.       HT =   3.0000000E-03
INTEG RTN.       HT =   4.0000000E-03
INTEG RTN.       HT =   4.0000000E-03

         2SDF

 21.5975000E-01 21.5975000E-01 63.2631559E+01  0.              69.6671216E-01 28.9742858E+01  0.              15.2774539E-01
  0.           -17.1428822E-02  0.           25.9536036E-02 28.9746885E+01 99.7547497E+00 28.9746628E+01  0.
 38.6107223E-02 30.2104261E-02  0.          -95.9584970E-01  0.            -76.3504194E-03  0.              22.5753757E-02
  0.              0.            -15.3373938E-01  0.             -31.0410855E+00 12.4671000E+04  0.               0.
  0.              0.

       LGEAR

       DELTA           P               P2              FT              SR              SF              AA              FC2

 14.2748595E-02 19.6835899E+04  0.               24.9945052E+03-11.9077334E+00-25.0572254E+03-12.6964138E+00-31.8826156E+02
 12.3095817E-02 22.0409122E+04  0.               59.3532927E+03 21.6826008E-01-58.4734504E+03 32.3520563E+00 43.3517893E+01
 12.3095817E-02 22.0409122E+04  0.               59.3532927E+03 21.6826008E-01-58.4734504E+03 32.3520563E+00 43.3517893E+01

       HUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 57.9696255E-03 34.8649233E-02-14.4860248E+02  0.             -24.9889914E+03-13.1122876E+02  0.               14.2748595E-02
 25.7627953E-05 15.4966197E-04-15.2911705E+00  0.             -59.3536932E+03-15.4158575E+00  0.               12.3095817E-02
 25.7627953E-05 15.4966197E-04-15.2911705E+00  0.             -59.3536932E+03-15.4158575E+00  0.               12.3095817E-02

       SD2             SD1             S               S2D2            S2D1            S2              OHETD1          OHET
```

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SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 152

```
-56.7778974E+01 48.2796468E-01 12.0017484E-01  0.            0.            0.            -54.6345316E+01-31.8548379E+01
 23.4656614E-01-10.1235616E-02 14.4136350E-01  0.            0.            0.            -19.7639199E-01-28.6388743E+01
 23.4656614E-01-10.1235616E-02 14.4136380E-01  0.            0.            0.            -19.7639199E-01-28.6388743E+01
      FTRA           FTRB           FTRC           HTX           HTY           HTZ           FXM           FYM
-91.2990043E+01  0.            -14.3701031E+04  0.            53.2801124E+04  0.            -91.2990043E+01  0.
      FZM            LM             MM             NM
-14.3853946E+04  0.            54.3613697E+04  0.
      VPCS
 38.7489980E+02
      TFFS
  0.            0.
                                                                T(I)
               0.            0.
      SAC1
 32.4744315E-03 31.2633643E-03-14.7236739E-02  0.            0.            79.6697768E-04  0.
                                                        LANDING ROLL
                              ISS =  1          ILR = 1            ICS = 0          IBS = 1
      AUTS
      TI             TR
 17.1500000E-02 19.8825000E-01
                                                        PITCH AUTOPILOT
      DELON          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE
 30.2996470E-01 21.1198847E-02-95.9584970E-01  0.            21.1198847E-02 80.0000000E-01
INTEG RTN.     HT =  4.0000000E-03
INTEG RTN.     HT =  2.0000000E-03
                              TIRE DEFLECTION EXCEEDED          DELTA(1) =   1.9992265E-01
INTEG RTN.     HT =  2.0000000E-03
      2SDF
 21.8575000E-01 21.8575000E-01 63.8164365E+01  0.            69.5654273E-01 28.9697775E+01  0.            27.7881913E-02
  0.            -15.8695247E-02  0.            25.9492156E-02 28.9697968E+01 99.7213584E+00 28.9697657E+01  0.
```

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ORIGINAL PAGE IS
OF POOR QUALITY

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                                  SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                       GENERALIZED COMPUTER PROGRAM

                         INDSDF  2      CASE LROLL        STAGE  1      PAGE     153

38.4155056E-02 54.9588480E-03  0.             -94.2329996E-01  0.              -75.9762512E-03  0.               -21.0184683E-03
 0.             0.            -21.5703210E-01  0.              -33.6662808E+00 12.4671000E+04  0.                 0.
 0.             0.

    LGEAR

    DELTA          P              P2             FT             SR             SF             AA             FC2

19.9922651E-02 32.0249699E+04  0.                           36.9345486E+03-23.4946757E+00-36.9669574E+03-65.6050140E-01-12.0921624E+02
12.3059383E-02 21.9113897E+04  0.                           59.3288822E+03 27.1577958E-02-58.4436079E+03 32.5517919E+00 13.8306244E+01
12.3059383E-02 21.9113897E+04  0.                           59.3288822E+03 27.1577958E-02-58.4436079E+03 32.5517919E+00 13.8306244E+01

    MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

85.5803838E-03 51.4777783E-02-31.6091797E+02  0.                           -36.9352053E+03-26.8043963E+02  0.               19.9922651E-02
10.3285636E-05 62.1332017E-05 61.2782133E-01  0.                           -59.3288823E+03 61.7801197E-01  0.               12.3059383E-02
10.3285636E-05 62.1332017E-05 61.2782133E-01  0.                           -59.3288823E+03 61.7801197E-01  0.               12.3059383E-02

    SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-62.2291764E+05 30.7018214E-01 13.0432099E-01  0.              0.              0.            -11.1684984E+02-33.9866216E+01
64.9373522E-02-57.1808636E-03 14.3939805E-01  0.              0.              0.             79.2052816E-02-28.6406004E+01
64.9373522E-02-57.1808636E-03 14.3939805E-01  0.              0.              0.             79.2052816E-02-28.6406004E+01

    FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

-32.0574011E+02  0.           -15.5591806E+04  0.             93.6880372E+04  0.            -32.0574011E+02  0.

    FZM            LM             MM             NM

-15.5863898E+04  0.            94.7765666E+04  0.

      VPCS

38.7489900E+02

      TFFS

 0.             0.

                                                              T(I)
                0.             0.

      SAC1

32.4861312E-03 32.2614879E-03-15.9583011E-02  0.              0.              82.0270827E-04  0.

                                                  LANDING ROLL
                          ISS =  1          ILR = 1          ICS = 0          IBS = 1
    AUTS
```

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SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 154

TI	TR
17.1500000E-02	20.1425000E-01

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
30.2996470E-01	21.1198847E-02	-94.2329996E-01	0.	21.1198847E-02	80.0000000E-01

STOP

APPENDIX F

AIRPLANE B FLEXIBLE BODY EXAMPLE 3

```
STCASE TAB
ATAB01      2
ATAB02      2
ATAB80      2
ATAB10      2
ATAB11      2
ATAB12      2
ATAB15      2
ATAB16      2
ATAB51      2
ATAB52      2
ATAB53      2
ATAB56      2
ATAB57      2
CTAB01      13
CTAB02      13
FTAB02      5
FTAB03      20
TTAB10      50
VTAB01      5
VTAB02      5
VTAB03      5
VTAB04      5
VTAB06      5
       TRA
REM    BCD 3SDF2-PLANPLANE
NCASE  BCD 1LROLL
REM    BCD 4INTEGRATION INFORMATION
IVARBH      0
THAX        40.
AMINER      .00005
PRTMIN      .0
AMAXER      .001
DELTS       .001
PRINT       .05
REM    BCD 3REQD FOR SDF-2
AMASS       3874.899
HGC7F       10.0
GAM7D       -1.16060
VG77F       296.22076
THTBD       16.3394
RWMGR       .0
INDAPC      1
INDADD      1
INDFPA      1
INDPLA      1
INDACM      2
INDGRT      1
INDWGT      1
REM    BCD 5VEHICLE PHYSICAL PROP. DATA
INDVPC      1
XCGRF       .0
VTAB01      2,0.,0.,5000.,1.
VTAB02      2,0.,1.59702E+6,5000.,1.59702E+6
VTAB03      2,0.,1.59702E+6,5000.,1.59702E+6
VTAB04      2,0.,1.59702E+6,5000.,1.59702E+6
INDXZS      1
VTAB06      2,0.,1.0E+5,5000.,1.0E+5
REM    BCD 4AERODYNAMIC INPUT DATA
INDAER      1
AREFF       1605.
D1RFF       37.7
D2RFF       56.7
INDA01      1
ATAB01      -7.9573427E-3,-5.5941985E-3
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
ATABC2      1.4021979E-3,8.8931664E-4
INDAC2      1
INDA80      1
ATAB80      4.18351E-2,2.03844E-2
INDA10      1
ATAB10      -3.978321E-2,-3.9650349E-2
INDA11      1
ATAB11      5.7452448E-2,3.7645688E-2
INDA12      1
ATAB12      1.472.279E-3,1.2354312E-3
INDA15      1
ATAB15      -1.725E-2,-1.45E-2
INDA16      1
ATAB16      1.25E-4,5.0E-5
INDA51      1
ATAB51      7.3516484E-3,1.7027972E-3
INDA52      1
ATAB52      -5.2147852E-4,1.0238928E-3
INDA53      1
ATAB53      -3.13686312E-4,1.8065268E-5
INDA56      1
ATAB56      8.7E-3,7.3418182E-3
INDA57      1
ATAB57      2.0E-5,3.63636366E-5
REM     BCD 3ENGINE THRUST DATA
INDTFF      3
INDTSO      1
IT10X       4
TTAB10      -2.,-1.5,-1.,-.5,0.,.5,1.,1.5,2.
TTAB10      0.,.1,.2,.3                              10
TTAB10      0.,0.,0.,0.,0.                           14
TTAB10      0.,0.,0.,0.                              19
TTAB10      0.,0.,0.,0.,0.                           23
TTAB10      0.,0.,0.,0.                              28
TTAB10      0.,0.,0.,0.,0.                           32
TTAB10      0.,0.,0.,0.                              37
TTAB10      0.,0.,0.,0.,0.                           41
TTAB10      0.,0.,0.,0.                              46
IT10W       9
REM     BCD 3LANDING GEAR DATA
NSTRUT      3
MASS        4.94..5.,27.19587,27.19587
RX          35..833,-2.83867,-2.83867
RY          0.,-8.3333,+8.3333
RZ          1.91667,.509583,.509583
THETAD      0.,0.,0.
ERDEG       0.
RGR         4.47
NTIRES      2.,3.,3.
RZERO       1.0479167,1.13125,1.13125
W           .594167,.634167,.604167
DELTAM      .198333,.1958333,.19583333
RLT         1.5E+3
IFD         1
AI          1.320.4533E+5,3.8129286E+5,3.8129286E+5
BI          1.2112257,1.412391,1.412391
FTABC2      2,0.,..,1.5E+4,..
FTABC3      6,0.,...,.007,.336,.1,.336,.4,.336,1.,.336,100.,.336
MOMENT      1.2,2.6,2.6
MB          0.,..,.
RF          5.48333,6.8792,6.8792
VZ          0.
PZERO       35280.,4032.,4.320.
VZERO       0.1614583,.4716435,.4716435
A           .1104166,.2673611,.2673611
```

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ORIGINAL PAGE IS
OF POOR QUALITY

```
IL               1
INOCC1           1
NSMAIN           2
CTAB01           0.,1.6667,1.,2.,3.
CTAB01           136.781,136.781,443.92,443.92,443.92,443.92,443.92           6
CTAB01           443.92                                                        13
INOCC2           1
CTAB02           0.,1.6667,1.,2.,3.
CTAB02           136.781,136.781,4.23E+4,4.23E+4,4.23E+4,4.23E+4               6
CTAB02           4.23E+4,4.23E+4                                               12
MUS              .1,.1,.1
ES               .0001333,.00016667,.00016667
SB               1.333,1.6667,1.6667
REM      BCD 4FLEXIOLE AIRFRAME DATA
INDFLX           1
NMODE            4
GMASS1           66.6517,79.4557,70.8341,18.1131
GFREQ            263.76,330.24,60.1,18,867.96
SZMOD            .08,-.11,-.13,-.12,-.0042,-.0042
SZMOD            -.153,.1393,.1393,-.065,.0112,.0112                      7
ARMODE           0.,0.,-.1140,0.,-4.239E-4,0.
ARMODE           0.,0.,-.0414,0.,3.6430E-4,0.                             7
ARMODE           0.,0.,.2435,0.,-6.030E-4,0.                              13
ARMODE           0.,0.,.1644,0.,-3.034E-5,0.                              19
NPTS             4
OUTMOD           0.,0.,0.,0.,0.,0.,0.,0.,.1970,-.0385,.0035,.0035
OUTMOD           0.,0.,0.,0.,0.,0.,0.,0.,.0800,-.0200,-.153,-.065         13
OUTMOD           0.,0.,0.,0.,0.,0.,0.,0.,-.150,-.0042,.1393,.0112         25
OUTMOD           0.,0.,0.,0.,0.,0.,0.,0.,.2030,-.2440,-.1072,-.125        37
ROIS             42.6667,0.,0.,35.0833,0.,1.91667
ROIS             -2.83867,8.3333,.509583,-32.3333,0.,0.                   7
REM      BCD 3PLOT TAPE DATA
IPLT             0
REM      BCD 3AUTOPILOT DATA
REM      BCD 3A. ENGINE DATA
INDAUT           1
IN               2
ZN               -.55,-.55
YN               -14.1667,14.1667
N                0.,0.
REM      BCD 3B. DRAG CHUTE DATA
ICS              0
CDCH             .244
SSH              1605.
XCH              -9.625
YCH              0.
ZCH              -2.41667
REM      BCD 5C. PHASE BEGIN-TERMINATE
ITO              0
HF               12.25
NF               0
XRF              0.
HRF              8.796
DELTAH           3.
NLRI             0
TI               0.
KP               0
VS               10.
XS               3000.
TS               12.
HS               0.
REM      BCD 4G. HOLD MANEUVER DATA
ALPDES           11.5
TTD              0.
KE       INT 1,1
```

```
PM              1.5
REM      BCD 5A. LANDING ROLL MANEUVER DATA
TSP             0.
TRV             0.
TCH             7.
TBK             0.
ISS             0.
ILR             0
IBS             0
REM      BCD 5I. ENGINE FAILURE STAGE DATA
IC       INT 0,0
XRF1            0.
IT1      INT 0,0
XRF2            0.
IT2      INT 0,0
H1              0.
IH1      INT 0,0
H2              0.
IH2      INT 0,0
HR1             0.
IHR1     INT 0,0
HR2             0.
IHR2     INT 0,0
TR1             0.
ITR1     INT 0,0
TR2             0.
ITR2     INT 0
REM      BCD 5J. BRAKE COND.STAGE DATA
IB       INT 0,0,0
TBK1            1.
IBK1     INT 0,0,0
TBK2            1.
IBK2     INT 0,0,0
REM      BCD 4K. PITCH AUTOPILOT DATA
TST             .2
ALPDL           2.
RFALPH          6.
DELALA          .01
PSH             0.
PSH2            0.
RFALP2          0.
DELQF           8.
DELQTO          0.
DELQL           -10.
DELQU           +25.
DELFD1          5.25
REM      BCD 4L. YAW AUTOPILOT DATA
RFB             .5
DELBA           .05
PSR             10.
DPSIA           .05
RFPSI           .5
PSPSI           0.
DELRL           -20.
DELRU           +20.
REM      BCD 4M. ROLL AUTOPILOT DATA
RFPHI           .5
DPHIA           .05
PSA             -10.
DELPL           -12.
DELPU           +12.
REM      BCD 5N,THROTTLE AUTOPILOT DATA
TF       INT 0,0
NDF             0.,0.
IR       INT 0,0
```

```
NB              1.,1.
NLR             0.,0.
NTO             0.,0.
K2              1.
REM      BCD 40. BRAKE AUTOPILOT DATA
MBC             0.,0.,0.
PD              .1
DELTAW          .001
OMEC01          20.
MBL             0.,0.,0.
MBU             0.,0.,0.
REM      BCD 5P. CONTROL RESPONSE DATA
DELHS           5.25
DELRRD          31.5
DELA            10.
NE01            .1
REM      BCD 4Q. INITIALIZATION
IAP             3
HR              10.
DELQD           4,56478
DELQDE          4.56478
DELQN           4.56478
DELPD           0.
DELRD           0.
MANLOG          1
PITCHP          1
REM      BCD 2STAGING DATA
REM      BCD 4A.GEARS INTO PROGRAM
INDLG           0
ISTAGE          0
DECRES   BCD 1HR
STESTD          11.0
         TRA
INDLG           -1
REM      BCD 40.SMOOTH IMPACT STAGE
AINCRS   BCD 3DDELT1DDELT2DDELT3
STEST           -.05,-.05,-.05
         TRA
PRINT           .02
DELTS           .005
AMAXER          .0005
PRTMIN          0.
AINCRS   BCD 1TIMES
STEST           .9
         TRA
ATAB51          7.3516484E-3,1.7027972E-3
ATAB52          -5.2147852E-4,1.0238928E-3
ATAB53          -3.1368831E-4,1.8065268E-5
ATAB56          0.,0.
ATAB57          0.,0.
REM      BCD 5C. EFFICIENT AMAXER STAGE
AINCRS   BCD 4DELTA1DELTA2DELTA3
STEST           .1,.1,.1
         TRA
PRINT           .05
AMAXER          .01
DELTS           .01
REM      BCD 40.SMOOTH IMPACT STAGE
AINCRS   BCD 1DDELT1
STEST           -.05
         TRA
PRINT           .02
DELTS           .005
AMAXER          .0005
REM      BCD 5E. EFFICIENT AMAXER STAGE
```

```
AINCRS BCD 1DELTA1
STEST      .1
      TRA
PRINT      .05
AMAXER     .01
DELTS      .01
INDSTF     1
      TRA
```

F-7

A.GEARS INTO PROGRAM

INITIAL PRINT OUT FOR VPCS

XCGRF	AREFF	D1RFF	D2RFF
0.	16.0500000E+02	37.7000000E+00	56.7000000E+00

PRINT CODES IDENTIFYING TIME HISTORY

2SOF

TIME	TIMES	XG77F	YG77F	HGC7F	U77F	V77F	W77F
PI77R	QI77R	RI77R	AMACH	VA77F	DYNPP	XG77F1	YG77F1
ZG77F1	ALPHD	BETAD	ALPHD1	BETAD1	GAM7D	SIG7D	THIPD
PSIPD	PHIPD	AX77F	AY77F	AZ77F	WTR7P	FDC	FCX
FCY	FCZ						

VPCS

AMASS

TFFS

HT	HT

SAC1

CAVAH	CA	CN	CY	CL	CM	CNN

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 8

2SOF

0.	0.	0.	0.	10.0000000E+00	29.0274042E+01	0.	59.0569126E+00
0.	0.	0.	26.5337670E-02	29.6220760E+01	10.4252977E+01	29.6159990E+01	0.
59.9992281E-01	11.4999986E+00	0.	0.	0.	-11.6059853E-01	0.	10.3393988E+00
0.	0.	57.7454851E-01	0.	-31.6515539E+00	12.4671000E+04	0.	0.
0.	0.						

VPCS

38.7489900E+02

TFFS

0. 0.

T(1)

0. 0.

SAC1

29.7745819E-03 -20.8749533E-03 60.9750569E-02 0. 0. 15.3281670E-03 0.

FLARE

AUTS

ALPDES	PHIDES	TTD
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
26.8544760E-01	-14.0024531E-07	0.	0.	-14.0024531E-07	26.8544760E-01

INTEG RTN. HT = 1.00000000E-03

2SOF

0.	0.	0.	0.	10.0000000E+00	29.0274042E+01	0.	59.0569126E+00
0.	0.	0.	26.5337670E-02	29.6220760E+01	10.4252977E+01	29.6159990E+01	0.
59.9992281E-01	11.4999986E+00	0.	0.	0.	-11.6059853E-01	0.	10.3393988E+00
0.	0.	90.1422983E-02	0.	-26.3302709E+00	12.4671000E+04	0.	0.
0.	0.						

VPCS

38.7489900E+02

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
                  INDSOF  2     CASE LROLL       STAGE  1     PAGE      9

     TFFS
 0.             0.

                0.                   0.                          T(I)
     SACI
29.7745819E-03-20.0749533E-03 60.9758569E-02  0.           0.           15.3281678E-03  0.

                                                            FLARE
   AUTS
   ALPDES         PHIDES         TTD
11.5000000E+00  0.             0.
                                                        PITCH AUTOPILOT
   DELON          ALPHAE         ALPHD1        ALPOD1        ALPHET        DELODE
27.5607208E-01-14.0024531E-07  0.            0.            -14.0024531E-07 27.5607208E-01

             STAGE ON--DECR. HR
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 10

```
INDLG          -1
REM      BCD   40.SMOOTH IMPACT STAGE
AINCRS   BCD   30DELT10DELT2CDELT3
STEST          -.05,-.05,-.05
         TRA
```

2SDF

0.	0.	0.	0.	10.0000000E+00	29.0274042E+01	0.	59.0569126E+00
0.	0.	0.	26.5337670E-02	29.6220760E+01	10.4252977E+01	29.6159990E+01	0.
59.9992281E-01	11.4999986E+00	0.	0.	0.	-11.6059853E-01	0.	10.3393988E+00
0.	0.	90.1422983E-02	0.	-26.3302709E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	35.2800000E+03	0.	0.	31.9713310E-01	-38.9549765E+02	-78.6562277E+01	0.
0.	40.3200000E+03	0.	0.	54.9315280E-01	-10.7799996E+03	-39.6383699E+01	0.
0.	40.3200000E+03	0.	0.	54.9315280E-01	-10.7799996E+03	-39.6383699E+01	0.

MUVP	VGPT	FTRX	FTRY	FTRZ	HA	HB	DDELTA
33.6000000E-02	29.6159990E+01	0.	0.	-0.	0.	0.	-79.6895154E-01
33.6000000E-02	29.6159990E+01	0.	0.	-0.	0.	0.	-10.9046626E-01
33.6000000E-02	29.6159990E+01	0.	0.	-0.	0.	0.	-10.9046626E-01

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
0.	0.	0.	0.	0.	0.	0.	0.

FZM	LM	MM	NM
0.	0.	0.	0.

VPCS
38.7489900E+02

TFFS	
0.	0.

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
                 INDSDF  2      CASE LROLL        STAGE  1      PAGE      11

                                                    T(I)
           0.                0.
     SAC1
29.7745819E-03-20.8749533E-03 60.9750569E-02  0.            0.            15.3281670E-03  0.
     FLEX
    POINT           XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
    XD1T            YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.              90.1422650E-02  0.              0.              0.             -20.9135646E+00  0.
29.0274042E+01  0.              0.              0.              59.0569126E+00  0.              0.             -55.8126135E-07
20.0000000E-01  0.              10.1746929E-01  0.              0.              0.             -28.4544208E+00  0.
29.0274042E+01  0.              0.              0.              59.0569126E+00  0.              0.             -33.2846020E-07
30.0000000E-01  0.              93.2276373E-02  0.              0.              0.             -26.1584011E+00  0.
29.0274042E+01  0.              0.              0.              59.0559126E+00  0.              0.              37.9673791E-07
40.0000000E-01  0.              90.1422602E-02  0.              0.              0.             -24.3726223E+00  0.
29.0274042E+01  0.              0.              0.              59.0569126E+00  0.              0.             -62.9045083E-07
                                                                FLARE
    AUTS

    ALPDES          PHIDES          TTO

11.5000000E+00  0.              0.
                                                        PITCH AUTOPILOT
    DELON           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

27.5339224E-01-14.0024531E-07  0.              0.             -14.0024531E-07 27.5339224E-01
INTEG RTN.        HT =   8.00000000E-04
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
```

```
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
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INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.50000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.50000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.50000000E-03

    2SDF

50.0000000E-03 50.0000000E-03 14.8031852E+00  0.                             96.9255670E-01 29.0027316E+01  0.                             59.3319920E+00
 0.            27.2368936E-04  0.                 26.5170101E-02 29.6034600E+01 10.4122497E+01 29.5967086E+01  0.
62.9389921E-01 11.5616902E+00  0.                 12.6453926E-01  0.                -12.1824188E-01  0.                             10.3434483E+00
 0.             0.                94.7824235E-02  0.               -26.7931117E+00 12.4671000E+04  0.                              0.
 0.             0.

    LGEAR

    DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.             31.6173890E-01-38.9549765E+02-78.8562277E+01  0.
 0.            40.3200000E+03  0.             0.             49.9512117E-01-10.7799996E+03-39.6383699E+01  0.
 0.            40.3200000E+03  0.             0.             49.9512117E-01-10.7799996E+03-39.6383699E+01  0.

    HUVP           VGPT           FTRX           FTRY           FTRZ           HA             HB             DDELTA
```

```
33.6000000E-02 29.5969757E+01  0.            0.            -0.            0.            0.            -76.6404400E-01
33.6000000E-02 29.5985272E+01  0.            0.            -0.            0.            0.            -78.2915523E-02
33.6000000E-02 29.5988272E+01  0.            0.            -0.            0.            0.            -78.2915523E-02

     SD2            SD1             S             S2D2           S2D1            S2            ONETD1          ONET

0.             0.             0.            0.             0.             0.            0.             0.
0.             0.             0.            0.             0.             0.            0.             0.
0.             0.             0.            0.             0.             0.            0.             0.

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

0.             0.             0.            0.             0.             0.            0.             0.

     FZM            LM             MM             NM

85.1226982E-04  0.            71.0026346E-03  0.

      VPCS

38.7489900E+02

      TFFS

0.             0.

                                                        T(1)
                    0.            0.

      SAG1

38.0142493E-03-21.9778889E-03 62.1246580E-02  0.            0.            12.2577486E-03  0.

      FLEX

     POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.            94.7507440E-02  0.             0.            -23.7644783E-08-20.8565931E+00  0.
29.0027316E+01  0.             0.            -29.4250924E-08 59.2157808E+00  0.             0.            -56.1122872E-07
20.0000000E-01  0.            10.4024866E-01  0.             0.             23.0909337E-05-20.4894263E+00  0.
29.0032536E+01  0.             0.            -69.7159365E-08 59.2364352E+00  0.             0.            -33.9792588E-07
30.0000000E-01  0.            97.2487508E-02  0.             0.            -16.0507208E-05-26.6560058E+00  0.
29.0028704E+01  0.             0.             67.9929249E-08 59.3397243E+00  0.             0.             35.7456793E-07
40.0000000E-01  0.            94.8063795E-02  0.             0.             10.8097006E-06-25.2295520E+00  0.
29.0027316E+01  0.             0.            -63.9733678E-08 59.4200572E+00  0.             0.            -64.2851107E-07
                                                          FLARE
     AUTS
```

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F-15

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INOSOF 2 CASE LROLL STAGE 1 PAGE 14

ALPDES	PHIDES	TTO
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELODE
28.3036816E-01	61.6902407E-03	12.6453926E-01	0.	61.6902407E-03	28.3036816E-01

```
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 15

```
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
INTEG RTN.     HT =  1.6000000E-03
```

2SDF

10.0000000E-02	10.0000000E-02	29.5966730E+00	0.	93.7100927E-01	28.9775565E+01	0.	59.6380378E+00
0.	48.1984443E-04	0.	26.5000399E-02	29.5844872E+01	10.3990476E+01	29.5772046E+01	0.
65.6393767E-01	11.6257361E+00	0.	12.9189539E-01	0.	-12.7133084E-01	0.	10.3544050E+00
0.	0.	99.5793099E-02	0.	-27.2803164E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	35.2800000E+03	0.	0.	31.1788275E-01	-38.9549765E+02	-78.8562277E+01	0.
0.	40.3200000E+03	0.	0.	44.7121839E-01	-10.7799996E+03	-39.6383699E+01	0.
0.	40.3200000E+03	0.	0.	44.7121839E-01	-10.7799996E+03	-39.6383699E+01	0.

HUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	29.5776739E+01	0.	0.	-0.	0.	0.	-73.4935148E-01
33.6000000E-02	29.5809538E+01	0.	0.	-0.	0.	0.	-46.1087834E-02
33.6000000E-02	29.5809538E+01	0.	0.	-0.	0.	0.	-46.1087834E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
0.	0.	0.	0.	0.	0.	0.	0.

FZM	LM	MM	NM
-11.9013294E-03	0.	-64.1789723E-03	0.

VPCS

38.7489980E+02

TFFS

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

0. 0.

T(I)

0. 0.

SAG1

30.2764715E-03 -23.1185661E-03 53.3346129E-02 0. 0. 98.5478628E-04 0.

FLEX

POINT / XD1T	XD2F / YD1F	XD2T / YD1T	YD2F / ZD1F	YD2T / ZD1T	ZD2F / XD0F	ZD2T / YD0F	XD1F / ZD0F
10.0000000E-01	0.	99.4801697E-02	0.	0.	-46.1024553E-05	-28.8029586E+00	0.
28.9775565E+01	0.	0.	-12.2026162E-07	59.4123897E+00	0.	0.	-57.2681676E-07
20.0000000E-01	0.	10.6335725E-01	0.	0.	-18.1776925E-05	-28.5321778E+00	0.
28.9784803E+01	0.	0.	-14.1871366E-07	59.4489403E+00	0.	0.	-34.6909363E-07
30.0000000E-01	0.	10.1403913E-01	0.	0.	25.2714542E-05	-27.1788028E+00	0.
28.9778021E+01	0.	0.	14.4725298E-07	59.6317212E+00	0.	0.	39.5466867E-07
40.0000000E-01	0.	99.6543978E-02	0.	0.	-41.8761248E-05	-26.1272092E+00	0.
28.9775565E+01	0.	0.	-19.0476411E-07	59.7738773E+00	0.	0.	-65.5620690E-07

FLARE

AUTS

ALPDES	PHIDES	TTD
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELODE
29.1245665E-01	12.5736064E-02	12.9189539E-01	0.	12.5736064E-02	29.1245665E-01

```
      2SDF

 62.1500000E-02 62.1500000E-02 18.2926428E+01  0.                 72.9115865E-01 28.8828436E+01  0.                 47.5712263E+00
  0.              -56.3983248E-03  0.           26.2199277E-02 29.2719810E+01 10.1811336E+01 29.2715414E+01  0.
-16.0417604E-01 93.5287958E-01  0.            -63.4966603E-01  0.             31.3996816E-02  0.                96.6687600E-01
  0.              0.            62.2618457E-01  0.            -47.7308204E+00 12.4671000E+04  0.                 0.
  0.              0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

  0.            35.2800000E+03  0.             0.            -62.5657526E-01-38.9549765E+02-78.8562277E+01  0.
11.6749011E-02 27.4933394E+04  0.            53.9082090E+03-25.5789495E+00-52.5644288E+03 49.4111885E+00 19.7896857E+03
11.6749011E-02 27.4933394E+04  0.            53.9082090E+03-25.5789495E+00-52.5644288E+03 49.4111885E+00 19.7896857E+03

     MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 29.2641532E+01  0.             0.            -0.             0.             0.            -48.3957621E-01
41.3030996E-03 25.5320618E-02 23.0793144E+02  0.            -55.0778216E+03 23.4139873E+02  0.             11.6749011E-02
41.9030996E-03 25.5320618E-02 23.0793144E+02  0.            -55.0778216E+03 23.4139873E+02  0.             11.6749011E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.             0.             0.             0.             0.             0.             0.             0.
-78.8491313E-01-68.3989232E-02 15.0536198E-01  0.             0.             0.            30.0179324E+01-28.8540956E+01
-78.8491313E-01-68.3989232E-02 15.0536198E-01  0.             0.             0.            30.0179324E+01-28.8540956E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

23.0476008E+03  0.            -10.7816418E+04  0.            -16.5771147E+04  0.            23.0476008E+03  0.

     FZM            LM             MM             NM

-10.7772683E+04  0.            -16.4045669E+04  0.

      VPCS

38.7489900E+02

      TFFS

  0.              0.

                                                       T(I)
                 0.             0.

      SAC1

32.1639271E-03-65.9787601E-04 47.2255551E-02  0.             0.            17.6467818E-03  0.
```

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SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                    INDSOF  2      CASE LROLL        STAGE  1      PAGE      61

   FLEX

    POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
    XD1T           YD1F           YD1F           Z01F           Z01T           XD0F           YD0F           Z00F

10.0000000E-01  0.             60.0179868E-01  0.             0.             13.0502055E+00-33.2022863E+00  0.
28.8828447E+01  0.              0.             76.9504806E-03 50.0545072E+00  0.              0.            -19.8321887E-05
20.0000000E-01  0.             60.4463816E-01  0.             0.             85.3002256E-01-37.9913177E+00  0.
28.8720344E+01  0.              0.             31.4571523E-03 49.5813228E+00  0.              0.            -90.8316526E-06
30.0000000E-01  0.             62.2192740E-01  0.             0.            -94.4761321E-01-57.2784095E+00  0.
28.8799690E+01  0.              0.            -38.7750153E-03 47.3723550E+00  0.              0.             11.0569336E-05
40.0000000E-01  0.             63.1962868E-01  0.             0.             15.4945582E+00-33.3565560E+00  0.
28.8828447E+01  0.              0.             83.4054559E-03 45.8310878E+00  0.              0.            -20.6224892E-05
                                                      LANDING RCLL
   AUTS                       ISS =  1          ILR = 1          ICS = 0          IBS = 1

    TI             TR

17.1500000E-02 45.0000000E-02

                                                      PITCH AUTOPILOT

   DELON          ALPHAE         ALPHD1         ALPOD1         ALPHET         DELODE

30.2996071E-01 21.1198852E-02-63.4966603E-01  0.             21.1198852E-02 43.4246071E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

     25DF

64.1500000E-02 64.1500000E-02 18.8780360E+01  0.             73.2593616E-01 28.8885617E+01  0.             46.9976214E+00
 0.           -56.7549533E-03  0.             26.2166853E-02 29.2683577E+01 10.1786030E+01 29.2677745E+01  0.
-10.4769952E-01 92.4026413E-01  0.           -48.6326306E-01  0.             36.1709290E-02  0.             96.0197245E-01
 0.              0.            49.3486208E-01  0.           -40.1321787E+00 12.4671000E+04  0.              0.
 0.              0.

   LGEAR

   DELTA           P              P2             FT             SR             SF             AA             FCZ

 0.            35.2800000E+03  0.              0.             33.1707709E-01-38.9549765E+02-78.8562277E+01  0.
94.9621857E-03 25.9692261E+04  0.             40.1882134E+03-22.6494581E+00-38.9053020E+03 47.1730232E+00 29.6171694E+03
94.9621857E-03 25.9692261E+04  0.             40.1882134E+03-22.6494581E+00-38.9053020E+03 47.1730232E+00 29.6171694E+03

   MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

                  INDSOF  2      CASE LROLL        STAGE  1      PAGE     62

 33.6000000E-02 29.2595039E+01  0.             0.            -0.             0.             0.           -49.3382829E-01
 54.9443288E-03 33.4772523E-02 22.6050053E+02  0.           -41.1416534E+03 23.4252916E+02  0.            94.9621857E-03
 54.9443288E-03 33.4772523E-02 22.6050053E+02  0.           -41.1416534E+03 23.4252916E+02  0.            94.9621857E-03

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.             0.             0.             0.             0.             0.             0.             0.
-71.9968675E-01-83.6761310E-02 14.9017865E-01  0.             0.             0.            30.0324251E+01-28.2543044E+01
-71.9968675E-01-83.6761310E-02 14.9017865E-01  0.             0.             0.            30.0324251E+01-28.2543044E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

 18.1827401E+03  0.           -80.3764268E+03  0.           -11.6220912E+04  0.            18.1827401E+03  0.

     FZM            LM             MM             NM

-80.0515636E+03  0.           -11.3082022E+04  0.

     VPCS

 38.7489900E+02

     TFFS

  0.             0.

                  0.                  0.                          T(I)

     SAC1

 32.1311769E-03-57.5046886E-04 46.1896663E-02  0.             0.             19.1094924E-03  0.

     FLEX

     POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

 10.0000000E-01  0.             47.9782349E-01  0.             0.             23.6389432E+00-16.6164467E+00  0.
 28.8885637E+01  0.              0.           -34.9907556E-04 49.4156689E+00  0.             0.           -35.0293301E-05
 20.0000000E-01  0.             48.2789303E-01  0.             0.             11.8417241E+00-28.3979406E+00  0.
 28.8776845E+01  0.              0.           -44.4173586E-04 48.9843307E+00  0.             0.           -15.0294245E-05
 30.0000000E-01  0.             49.4493967E-01  0.             0.            -14.2554604E+00-54.3810831E+00  0.
 28.8856885E+01  0.              0.            47.4154695E-04 46.8412544E+00  0.             0.            18.6525130E-05
 40.0000000E-01  0.             50.3933676E-01  0.             0.             24.8192763E+00-15.2195315E+00  0.
 28.8885637E+01  0.              0.           -28.7303260E-04 45.1596735E+00  0.             0.           -35.6932337E-05

                                                LANDING RCLL
                    ISS =  1          ILR = 1           ICS = 0          IBS = 1

     AUTS
```

TI	TR
17.1500000E-02	47.0000000E-02

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPCD1	ALPHET	DELODE
30.2996071E-01	21.1198852E-02	-48.6326306E-01	0.	21.1198852E-02	44.4746071E-01

```
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
```

2SDF

66.1500000E-02	66.1500000E-02	19.4633549E+01	0.	73.6406298E-01	28.8917664E+01	0.	46.5715091E+00
0.	-56.3925744E-03	0.	26.2134209E-02	29.2647095E+01	10.1760543E+01	29.2640652E+01	0.
-19.4179462E-01	91.5691297E-01	0.	-34.6325791E-01	0.	38.0176299E-02	0.	95.3708913E-01
0.	0.	36.3127050E-01	0.	-33.1960969E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	35.2800000E+03	0.	0.	23.4595310E-01	-38.9549765E+02	-78.8562227E+01	0.
72.3024238E-03	24.3786852E+04	0.	27.2734757E+03	-78.6478298E-01	-26.3603627E+03	33.5754276E+00	38.1566536E+03
72.3024238E-03	24.3786852E+04	0.	27.2734757E+03	-78.6478298E-01	-26.3603627E+03	33.5754276E+00	38.1566536E+03

MUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	29.2550841E+01	0.	0.	-0.	0.	0.	-48.3130693E-01
71.8272747E-03	43.7622429E-02	20.1069908E+02	0.	-27.9935315E+03	21.2922491E+02	0.	72.3024238E-03
71.8272747E-03	43.7622429E-02	20.1069908E+02	0.	-27.9935315E+03	21.2922491E+02	0.	72.3024238E-03

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
-60.1866426E-01	-94.9762365E-02	14.7230918E-01	0.	0.	0.	27.2977553E+01	-27.6583554E+01
-60.1866426E-01	-94.9762365E-02	14.7230918E-01	0.	0.	0.	27.2977553E+01	-27.6583554E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
13.2420903E+03	0.	-54.5469514E+03	0.	-72.2346842E+03	0.	13.2420903E+03	0.

FZM	LM	MM	NM
-54.5460367E+03	0.	-71.2918574E+03	0.

VPCS

36.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.0945165E-03-50.7480311E-04 45.3740867E-02 0. 0. 20.4428364E-03 0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000000E-01	0.	35.0454299E-01	0.	0.	11.0509059E+00	-23.6054390E+00	0.
28.8917673E+01	0.	0.	-79.4741263E-03	48.8981200E+00	0.	0.	-16.6216720E-05
20.0000000E-01	0.	35.8934303E-01	0.	0.	50.5134628E-01	-29.3519110E+00	0.
28.8809582E+01	0.	0.	-36.6788638E-03	48.5132679E+00	0.	0.	-70.5386688E-06
30.0000000E-01	0.	36.5267391E-01	0.	0.	-65.2303501E-01	-39.6257333E+00	0.
28.4888922E+01	0.	0.	44.7160818E-03	46.4561453E+00	0.	0.	89.1015197E-06
40.0000000E-01	0.	37.4342545E-01	0.	0.	10.0983643E+00	-21.9946559E+00	0.
28.8917673E+01	0.	0.	-82.7820726E-03	44.6653690E+00	0.	0.	-16.0678336E-05

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI TR

17.1500000E-02 49.0000000E-02

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELODE
30.2996071E-01	21.1198852E-02	-34.6325791E-01	0.	21.1198852E-02	45.5246071E-01

```
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
```

2SDF

```
                                      SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                           GENERALIZED COMPUTER PROGRAM

                              INDSDF  2      CASE LROLL         STAGE  1      PAGE      65

68.1500000E-02 68.1500000E-02 20.0485980E+01  0.              74.0271440E-01 28.8925184E+01  0.                46.2783486E+00
 0.           -59.4258169E-03  0.             26.2099235E-02 29.2608010E+01 10.1733248E+01 29.2601811E+01  0.
-19.0476055E-01 91.0000619E-01  0.           -22.8324411E-01  0.             37.2975909E-02  0.                94.7290:31E-01
 0.             0.            25.0976350E-01  0.            -27.5595260E+00 12.4671000E+04  0.                 0.
 0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.            -37.8284010E-01-38.9549765E+02-78.8562277E+01  0.
50.9828185E-03 22.8281447E+04  0.            16.5774467E+03 11.2645990E+00-16.1310602E+03 16.4137616E+00 44.4533807E+03
50.9828185E-03 22.8281447E+04  0.            16.5774467E+03 11.2645990E+00-16.1310602E+03 16.4137616E+00 44.4533807E+03

     HUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.5000000E-02 29.2511431E+01  0.             0.            -0.              0.             0.            -40.2973379E-01
99.5736748E-03 60.6626169E-02 17.0177261E+02  0.            -17.0905875E+03 18.3836910E+02  0.             50.9828185E-03
99.5736743E-03 60.6626169E-02 17.0177261E+02  0.            -17.0905875E+03 18.3836910E+02  0.             50.9828185E-03

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

 0.             0.             0.             0.             0.             0.             0.             0.
-40.5689302E-01-10.2513772E-01 14.5249216E-01  0.             0.             0.            23.5688346E+01-27.1260558E+01
-40.5689302E-01-10.2513772E-01 14.5249216E-01  0.             0.             0.            23.5688346E+01-27.1260558E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

89.8275507E+02  0.           -33.1548935E+03  0.           -37.1156155E+03  0.            89.8275507E+02  0.

     FZM            LM             MM             NM

-33.7230366E+03  0.           -39.8335952E+03  0.

      VPCS

38.7489900E+02

      TFFS

 0.             0.

                                                              T(I)
                0.             0.

      SAC1

32.0568066E-03-45.4666551E-04 44.7570711E-02  0.             0.             21.6581905E-03  0.

      FLEX
```

```
                                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                          GENERALIZED COMPUTER PROGRAM

                              INDSDF  2      CASE LROLL          STAGE  1       PAGE     66

     POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.            23.8730248E-01  0.             0.            -12.4285771E+00-42.4857781E+00  0.
28.3925175E+01  0.             0.            -77.5969016E-03 48.5655884E+00  0.             0.            17.4994244E-05
20.0000000E-01  0.            25.1813304E-01  0.             0.            -58.6914904E-01-35.4883119E+00  0.
28.9818947E+01  0.             0.            -35.5569154E-03 48.1873122E+00  0.             0.            73.1879492E-06
30.0000000E-01  0.            25.4349457E-01  0.             0.             68.9434588E-01-20.5005720E+00  0.
28.8896945E+01  0.             0.             43.4343151E-03 46.1644473E+00  0.             0.           -88.9296312E-06
40.0000000E-01  0.            26.1815483E-01  0.             0.            -14.8111127E+00-40.4778727E+00  0.
28.3925174E+01  0.             0.            -81.6524049E-03 44.4045966E+00  0.             0.            19.5461193E-05

                                                          LANDING RCLL
                                    ISS =  1           ILR = 1         ICS = 0             IBS = 1
     AUTS

     TI             TR

17.1500000E-02 51.0000000E-02

                                                           PITCH AUTOPILCT

     DELON          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELODE

30.2956071E-01 21.1198852E-02-22.8324411E-01  0.             21.1198852E-02 46.5746071E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

       2SDF

70.1500000E-02 70.1500000E-02 20.6337599E+01  0.             74.3955512E-01 28.8911295E+01  0.            46.0924470E+00
 0.           -54.0084499E-03  0.            26.2060697E-02 29.2564950E+01 10.1703199E+01 29.2559623E+01  0.
-17.6551788E-01 90.6448775E-01  0.           -13.7416649E-01  0.            34.5760876E-02  0.            94.1024801E-01
 0.             0.            16.2873324E-01  0.           -23.4251620E+00 12.4671000E+04  0.             0.
 0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.           -59.9779162E-01-38.9549765E+02-78.8562277E+01  0.
32.8207231E-03 21.3835431E+04  0.            88.3296626E+02 22.4395307E+00-86.2315092E+02 77.1497079E-01 48.2663001E+03
32.8207231E-03 21.3835431E+04  0.            88.3296626E+02 22.4395307E+00-86.2315092E+02 77.1497079E-01 48.2663001E+03
     MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 29.2474694E+01  0.             0.            -0.             0.             0.           -48.2728216E-01
14.5627181E-02 88.7088549E-02 13.3611354E+02  0.           -91.7489118E+02 14.6762623E+02  0.            32.8207231E-03
```

```
                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                  INDSDF  2       CASE LROLL         STAGE  1      PAGE     67

14.5627181E-02 88.7088549E-02 13.3611354E+02  0.          -91.7489118E+02 14.6762623E+02  0.          32.8287231E-03
      SD2             SD1             S             S2D2            S2D1            S2            OMETD1          OMET

 0.             0.             0.              0.              0.              0.              0.             0.
-15.8653088E-01-10.6819815E-01 14.3144304E-01  0.              0.              0.             18.8157209E+01-26.6998781E+01
-15.8653088E-01-10.6819815E-01 14.3144304E-01  0.              0.              0.             18.8157209E+01-26.6998781E+01
      FTRA            FTRB            FTRC          HTX             HTY             HTZ            FXH             FYH

56.3650055E+02  0.             -17.6659325E+03  0.             -13.6349513E+03  0.             56.3650055E+02  0.
      FZH             LH              HH            NH

-18.4512820E+03  0.             -18.0421941E+03  0.

      VPGS

38.7489900E+02
      TFFS

 0.             0.

                                                            T(I)
                0.              0.
      SAC1

32.0204557E-03-41.3319488E-04 44.3038154E-02  0.              0.             22.7764832E-03  0.
      FLEX

      POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.             15.0433651E-01  0.              0.             -23.9754921E+00-50.6633250E+00  0.
28.8911276E+01  0.              0.            -29.9972575E-05 48.3965094E+00  0.              0.             34.2695842E-05
20.0000000E-01  0.             16.7326610E-01  0.              0.             -11.6220579E+00-37.7355881E+00  0.
28.3807771E+01  0.              0.            -26.9643437E-04 47.9845452E+00  0.              0.             14.4938271E-05
30.0000000E-01  0.             16.7571040E-01  0.              0.             13.9046736E+00-93.0490509E-01  0.
28.8883783E+01  0.              0.             23.7563246E-04 45.9415105E+00  0.              0.            -17.7601609E-05
40.0000000E-01  0.             17.2338780E-01  0.              0.             -27.1758433E+00-48.1285169E+00  0.
28.1911275E+01  0.              0.            -28.9596092E-04 44.3432796E+00  0.              0.             37.0546554E-05
                                                         LANCING RCLL
                              ISS =  1           ILR = 1           ICS = 0           IBS = 1
      AUTS

      TI              TR
```

F-25

ORIGINAL PAGE IS
OF POOR QUALITY

17.1500000E-02 53.0000000E-02

PITCH AUTOPILOT

DELON	ALPHAE	ALFHD1	ALPDD1	ALPHET	DELODE
30.2996071E-01	21.1198852E-02	-13.7416649E-01	0.	21.1198852E-02	47.6246071E-01

INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03

2SDF

72.1500000E-02	72.1500000E-02	21.2186335E+01	0.	74.7216927E-01	28.8830577E+01	0.	45.9840934E+00
0.	-52.2970355E-03	0.	26.2018281E-02	29.2517563E+01	10.1670156E+01	29.2513423E+01	0.
-15.5630160E-01	90.4447735E-01	0.	-72.8095444E-02	0.	30.4837073E-02	0.	93.4931351E-01
0.	0.	95.8821551E-02	0.	-20.7061458E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FCZ
0.	35.2800000E+03	0.	0.	30.3044655E-02	-38.9549765E+02	-78.8562277E+01	0.
18.9969322E-03	20.0772929E+04	0.	40.4071906E+02	19.7472430E+00	-36.9762315E+02	12.6157357E+00	49.8264861E+03
18.9969322E-03	20.0772929E+04	0.	40.4071906E+02	19.7472430E+00	-36.9762315E+02	12.6157357E+00	49.8264861E+03

HUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	29.2434667E+01	0.	0.	-0.	0.	0.	-48.2256705E-01
20.5412640E-02	12.5109433E-01	87.0632992E+01	0.	-42.3845870E+02	96.8364216E+01	0.	18.9969322E-03
20.5412640E-02	12.5109433E-01	87.0632992E+01	0.	-42.3845870E+02	96.8364216E+01	0.	18.9969322E-03

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
61.6369794E-02	-10.8532535E-01	14.0980202E-01	0.	0.	0.	12.4149258E+01	-26.3970312E+01
61.6369794E-02	-10.8532535E-01	14.0980202E-01	0.	0.	0.	12.4149258E+01	-26.3970312E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
30.9523724E+02	0.	-80.8143812E+02	0.	-24.9773279E+02	0.	30.9523724E+02	0.

FZM	LM	MM	NM
-84.7022430E+02	0.	-50.2946407E+02	0.

VPCS

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

              INDSDF  2      CASE LROLL        STAGE  1      PAGE      69
38.7489900E+02
      TFFS

 0.            0.

                                                       T(I)
             0.            0.

      SAC1

31.9872647E-03-37.9998726E-04 43.9687907E-02  0.            0.            23.8220768E-03  0.

      FLEX

    POINT          XD2F          XD2T          YD2F          YD2T          ZD2F          ZD2T          XD1F
    XD1T           YD1F          YD1T          ZD1F          ZD1T          XD0F          YD0F          ZD0F

10.0000000E-01  0.            83.4105302E-02  0.            0.           -12.4232633E+00-36.9103681E+00  0.
28.8880569E+01  0.             0.            76.8612288E-03 48.2922966E+00  0.            0.            17.5460437E-05
20.0000000E-01  0.            10.2947647E-01  0.            0.           -76.4823030E-01-31.4685654E+00  0.
28.9760337E+01  0.             0.            31.0516843E-03 47.8498977E+00  0.            0.            78.1662372E-06
30.0000000E-01  0.            10.1585584E-01  0.            0.            84.8127057E-01-11.9747169E+00  0.
28.8853932E+01  0.             0.           -39.4058834E-03 45.7962338E+00  0.            0.           -93.6332751E-06
40.0000000E-01  0.            10.3926083E-01  0.            0.           -16.0425322E+00-33.8834252E+00  0.
28.9880567E+01  0.             0.            76.5742512E-03 44.3697319E+00  0.            0.            19.8270153E-05

                                                       LANDING RCLL
      AUTS                    ISS =  1         ILR = 1          ICS = 0          IBS = 1

      TI            TR

17.1500000E-02 55.0000000E-02

                                                      PITCH AUTOPILOT

      DELON         ALPHAE        ALPHD1        ALPCD1        ALPHET        DELQDE

30.2996071E-01 21.1198852E-02-72.8095444E-02  0.            21.1198852E-02 48.6746071E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

      2SOF

 74.1500000E-02 74.1500000E-02 21.8038106E+01  0.            75.0165391E-01 28.8837879E+01  0.            45.9258849E+00
  0.           -50.4215140E-03  0.            26.1972344E-02 29.2456250E+01 10.1634404E+01 29.2463333E+01  0.
-13.0628238E-01 90.3453071E-01  0.           -30.9215176E-02  0.            25.5909558E-02  0.            92.9043961E-01
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                          INDSOF  2     CASE LROLL        STAGE  1      PAGE      70
 0.            0.          52.1081790E-02  0.            -19.1648584E+00 12.4671000E+04  0.          0.
 0.            0.
   LGEAR
   DELTA           P              P2              FT              SR              SF              AA              FC2
 0.            35.2800000E+03  0.              0.              11.3823576E+00-38.9549765E+02-78.8562277E+01  0.
10.0299980E-03 18.9177408E+04  0.              16.2426103E+02  89.8108670E-01-95.7584714E+01  24.5138806E+00  49.5488229E+03
10.0299980E-03 18.9177408E+04. 0.              16.2426103E+02  89.8108670E-01-95.7584714E+01  24.5138806E+00  49.5488229E+03
   HUVP            VGPT           FTRX            FTRY            FTRZ            MA              MB              DDELTA
33.2000000E-02 29.2386276E+01  0.              0.              -0.             0.              0.             -48.1458424E-01
26.2279293E-02 15.9722319E-01  45.1023565E+01  0.              -17.1963086E+02 50.5696643E+01  0.              10.0299980E-03
26.2279293E-02 15.9722319E-01  45.1023565E+01  0.              -17.1963086E+02 50.5696643E+01  0.              10.0299980E-03
   SD2             SD1            S               S2D2            S2D1            S2              OMETD1          OMET
 0.             0.             0.              0.              0.              0.              0.              0.
17.4300439E-01-10.8229708E-01  13.8808741E-01  0.              0.              0.              64.8329029E+00-26.2131126E+01
17.4300439E-01-10.8229708E-01  13.8808741E-01  0.              0.              0.              64.8329029E+00-26.2131126E+01
   FTRA            FTRB           FTRC            MTX             MTY             MTZ             FXH             FYH
14.4544617E+02  0.            -32.4852205E+02  0.              46.3709320E+01  0.              14.4544617E+02  0.
   FZH             LH             MH              NH
-29.5378760E+02  0.            17.1154349E+02  0.
   VPCS
38.7489900E+02
   TFFS
 0.             0.
                                                              T(I)
                 0.             0.
   SAC1
31.9584130E-03-35.1687893E-04  43.7128778E-02  0.              0.              24.8175664E-03  0.
   FLEX
   POINT           XD2F           XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
   XD1T            YD1F           YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F
```

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                                            SIX DEGREES CF FREEDOM FLIGHT PATH STUDY
                                                GENERALIZED COMPUTER PROGRAM

                                   INDSDF  2      CASE LROLL         STAGE  1      PAGE      71

15.0000000E-01  0.            40.4644213E-02  0.                  0.            10.9379160E+00-12.3541786E+00  0.
28.8837887E+01  0.             0.             78.8256648E-03 40.1560302E+00  0.             0.            -16.3150578E-05
20.0000000E-01  0.            61.3616641E-02  0.                  0.            21.6388497E-01-20.4002358E+00  0.
28.3741241E+01  0.             0.             34.6043338E-03 47.7294424E+00  0.             0.            -61.3842233E-06
30.0000000E-01  0.            58.1869840E-02  0.                  0.           -38.4483784E-01-22.7406676E+00  0.
28.8812181E+01  0.             0.            -42.8216279E-03 45.7399333E+00  0.             0.             80.0127787E-06
40.0000000E-01  0.            59.5217053E-02  0.                  0.            81.8700538E-01-78.5721868E-01  0.
28.8837887E+01  0.             0.             79.8441265E-03 44.3754351E+00  0.             0.            -15.4209232E-05

                                                         LANDING ROLL
                                        ISS =  1         ILR = 1         ICS = 0           IBS = 1
    AUTS

    TI             TR

17.1500000E-02 57.0000000E-02

                                                         PITCH AUTOPILCT

    DELON          ALPHAE         ALPHD1         ALPCD1         ALPHET         DELODE

30.2996071E-01 21.1198852E-02-30.8215176E-02  0.             21.1198852E-02 49.7246071E-01

INTEG RTN.     HT =  1.00000000E-03
INTEG RTN.     HT =  1.00000000E-03
INTEG RTN.     HT =  1.00000000E-03
INTEG RTN.     HT =  1.00000000E-03
```

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                                  SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                      GENERALIZED COMPUTER PROGRAM

                              INOSDF  2      CASE LROLL        STAGE  1     PAGE    164

28.9810253E+01  0.                   0.          93.8205708E-04 10.7804519E+00  0.              0.                  25.5352649E-05
40.0000000E-01  0.                 74.9498310E-02  0.                0.           22.3545692E+00-13.1858212E+00  0.
28.9909540E+01  0.                   0.          -30.6885702E-03 50.0140966E-01  0.              0.                 -43.1604059E-05
                                                              LANDING RCLL
                                        ISS =  1          ILR = 1          ICS = 0          IBS = 1
   AUTS

   TI         TR

17.1500000E-02 18.0500000E-01

                                                             PITCH AUTOPILOT

   DELON          ALPHAE          ALPHO1          ALPOD1          ALPHET          DELODE

30.2996071E-01 21.1198852E-02-11.6023798E+00  0.              21.1198852E-02 80.0000000E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

    2SOF

19.5650000E-01 19.9650000E-01 58.3301328E+01  0.              70.0502176E-01 28.9916544E+01  0.              10.1435542E+00
 0.           -19.3791318E-02  0.           25.9846939E-02 29.0093940E+01 99.9937504E+00 29.0093884E+01  0.
18.0669951E-02 20.0363828E-01  0.          -11.4996016E+00  0.           -35.6867903E-03  0.              19.6815062E-01
 0.             0.           -72.1927051E-02  0.          -34.2246078E+00 12.4671000E+04  0.               0.
 0.             0.

   LGEAR

   DELTA          P               P2              FT              SR              SF              AA              FC2

75.4320830E-03 39.5622883E+03  0.              11.6667439E+03 41.3452007E-01-11.5840520E+03 16.7392634E+00-68.6782480E+02
13.1358965E-02 24.8347918E+04  0.              65.0147987E+03-90.2920789E-01-64.1555222E+03 31.5958453E+00 20.0573305E+02
13.1358965E-02 24.8347918E+04  0.              65.0147987E+03-90.2920789E-01-64.1555222E+03 31.5958453E+00 20.0573305E+02

   MUVP           VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

33.6000000E-02 24.6983789E+01-38.7756799E+02  0.             -11.5413809E+03-37.7087522E+02  0.              75.4320830E-03
21.3516027E-04 12.8527594E-03 13.8909147E+01  0.             -65.0579480E+03 13.8894011E+01  0.              13.1358965E-02
21.3516027E-04 12.8527594E-03 13.8909147E+01  0.             -65.0579488E+03 13.8894011E+01  0.              13.1358965E-02

   SD2            SD1             S               S2D2            S2D1            S2              OMETO1          OMET

-11.2812362E+00 70.8592770E-01 15.8277982E-02  0.               0.              0.            -15.7119801E+02-42.8757497E+00
-95.8838222E-01-21.7754120E-02 14.7766754E-01  0.               0.              0.             17.8069245E+00-28.8983989E+01
-95.8838222E-01-21.7754120E-02 14.7766754E-01  0.               0.              0.             17.8069245E+00-28.8983989E+01
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 165

FTRA	FTRB	FTRC	HTX	HTY	HTZ	FXM	FYM
12.6741053E+02	0.	-14.1696341E+04	0.	39.5604863E+03	0.	12.6741053E+02	0.

FZM	LM	MM	NM
-14.1928011E+04	0.	42.5151688E+03	0.

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.4388518E-03 25.3275264E-03-58.0017738E-03 0. 0. 57.1046230E-04 0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000000E-01	0.	-22.8265886E-01	0.	0.	-23.9998022E-01	-38.6835220E+00	0.
28.9916539E+01	0.	0.	-10.7378381E-02	18.3046119E+00	0.	0.	27.2843866E-06
20.0000000E-01	0.	-19.2807841E-01	0.	0.	79.8787513E-01	-28.0017011E+00	0.
28.3545112E+01	0.	0.	-48.7999158E-03	16.0935932E+00	0.	0.	-13.5740258E-06
30.0000000E-01	0.	-61.3599790E-02	0.	0.	-70.9534638E-01	-41.2021081E+00	0.
28.3817789E+01	0.	0.	59.0075433E-03	96.5245213E-01	0.	0.	11.2489923E-06
40.0000000E-01	0.	53.7085386E-02	0.	0.	20.2445228E-01	-30.6398725E+00	0.
28.9916538E+01	0.	0.	-11.5411390E-02	37.6222996E-01	0.	0.	30.6088668E-06

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
17.1500000E-02	18.2500000E-01

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
30.2996071E-01	21.1198852E-02	-11.4996016E+00	0.	21.1198852E-02	80.0000000E-01

```
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

        2SDF

 20.1650000E-01 20.1650000E-01 58.9102837E+01  0.                  70.0170697E-01 28.9917735E+01  0.                 89.9520866E-01
  0.           -19.2755592E-02  0.              25.9814070E-02 29.0057248E+01 99.9684666E+00 29.0057207E+01  0.
 15.4239824E-02 17.7713242E-01  0.             -11.2045767E+00  0.             -30.4672117E-03  0.             17.4666502E-01
  0.             0.            -88.4743995E-02  0.             -33.0203271E+00 12.4671000E+04  0.              0.
  0.             0.

        LGEAR

        DELTA          P              P2             FT             SR             SF             AA             FC2

 76.4645137E-03 44.2806890E+03  0.             11.8466726E+03-81.9600585E-01-11.6413819E+03 41.5568106E+00-63.9380716E+02
 12.8909443E-02 24.4385942E+04  0.             63.3144807E+03 72.8176613E-01-62.8323075E+03 17.7296484E+00 22.9036458E+02
 12.8909443E-02 24.4385942E+04  0.             63.3144807E+03 72.8176613E-01-62.8323075E+03 17.7296484E+00 22.9036458E+02

        MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 33.6000000E-02 21.6448440E+01-39.4194257E+02  0.            -11.7319719E+03-38.2940872E+02  0.             76.4645137E-03
 37.1530315E-04 22.3621761E-03 23.5368503E+01  0.            -63.3510899E+03 23.5919397E+01  0.             12.8909443E-02
 37.1530315E-04 22.3621761E-03 23.5368503E+01  0.            -63.3510899E+03 23.5919397E+01  0.             12.8909443E-02

        SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

 12.0175383E-01 68.3702046E-01 29.7226407E-02  0.              0.             0.            -15.9558697E+02-74.3598226E+00
-71.4763636E-01-23.2692361E-02 14.7302441E-01  0.              0.             0.             30.2460765E+00-28.8256664E+01
-71.4763636E-01-23.2692361E-02 14.7302441E-01  0.              0.             0.             30.2460765E+00-28.8256664E+01

        FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

 74.9926436E+01  0.            -13.8475634E+04  0.             52.9876494E+03  0.             74.9926436E+01  0.

        FZM            LM             MM             NM

-13.9268028E+04  0.             49.5090351E+03  0.

          VPCS

 38.7489900E+02

          TFFS

  0.             0.

                                                  T(I)

                 0.             0.
```

```
      SAC1

32.44232322E-03 26.0409137E-03-70.3270416E-03  0.              0.              60.7604035E-04  0.
      FLEX

    POINT             XD2F             XD2T             YD2F             YD2T             ZD2F             ZD2T             XD1F
    XD1T              YD1F             YD1T             ZD1F             ZD1T             XD0F             YD0F             ZD0F

10.0000001E-01  0.              -24.5094091E-01  0.               0.              -25.4321325E+00-60.7650911E+00  0.
28.9917666E+01  0.                0.             -49.4222890E-03 17.1700314E+00  0.               0.              36.0023430E-05
20.0000000E-01  0.              -20.7214029E-01  0.               0.              -53.4235612E-01-40.3369125E+00  0.
28.3548261E+01  0.                0.             -32.6273683E-03 15.7250835E+00  0.               0.              13.2137342E-05
30.0000000E-01  0.              -76.5605656E-02  0.               0.              79.9952076E-01-24.8944096E+00  0.
28.9819543E+01  0.                0.              35.9201415E-03 84.8395929E-01  0.               0.             -16.7206090E-05
40.0000000E-01  0.               34.1012222E-02  0.               0.              -24.7940055E+00-56.0758572E+00  0.
28.9917662E+01  0.                0.             -63.2953153E-03 26.9948898E-01  0.               0.              37.9884116E-05
                                                             LANDING ROLL
                                  ISS =  1         ILR = 1         ICS = 0         IBS = 1
    AUTS

    TI                TR

17.1500000E-02 18.4500000E-01

                                                            PITCH AUTOPILOT

    DELON             ALPHAE           ALPHD1           ALPDD1           ALPHET           DELODE

30.2996071E-01 21.1198852E-02-11.2045767E+00  0.              21.1198852E-02 80.0000000E-01

INTEG RTN.        HT =  1.00000000E-03
INTEG RTN.        HT =  1.00000000E-03
INTEG RTN.        HT =  1.00000000E-03
INTEG RTN.        HT =  1.00000000E-03
      2SDF

20.3650000E-01 20.3650000E-01 59.4903597E+01  0.              69.9867748E-01 28.9912032E+01  0.              78.7819604E-01
 0.           -19.1498972E-02  0.              25.9779856E-02 29.0019055E+01 99.9421508E+00 29.0019015E+01  0.
15.2488057E-02 15.5659743E-01  0.             -10.9101022E+00  0.             -30.1252300E-03  0.              15.2647209E-01
 0.             0.             -10.6828257E-01  0.             -31.9005405E+00 12.4671000E+04  0.               0.
 0.             0.
    LGEAR

    DELTA             P                P2               FT               SR               SF               AA               FC2

79.0289801E-03 50.1365425E+03  0.              12.3151786E+03-12.5358632E+00-12.1128786E+03 40.9514172E+00-61.9938076E+02
```

```
12.6796384E-02 24.0160893E+04  0.                  61.8590155E+03 12.7463742E+00-61.3936519E+03 17.1115565E+00 26.1963078E+02
12.6796384E-02 24.0160893E+04  0.                  61.8590155E+03 12.7463742E+00-61.3936519E+03 17.1115565E+00 26.1963078E+02
      MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA
33.6000000E-02 18.5248393E+01-41.0263473E+02  0.             -12.2142224E+03-39.7499241E+02  0.             79.0289801E-03
50.3667314E-04 30.6731952E-03 31.5429947E+01  0.             -61.8893813E+03 31.6834751E+01  0.             12.6796384E-02
50.3667314E-04 30.6731952E-03 31.5429947E+01  0.             -61.8893813E+03 31.6834751E+01  0.             12.6796384E-02
      SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET
-37.4702825E-01 67.3226602E-01 43.3300683E-02  0.              0.             0.            -16.5624684E+02-10.6758297E+01
-23.0465156E-01-24.8856998E-02 14.6790418E-01  0.              0.             0.             40.6198399E+00-28.7627031E+01
-23.0465156E-01-24.8856998E-02 14.6790418E-01  0.              0.             0.             40.6198399E+00-28.7627031E+01
      FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM
15.2042255E+01  0.            -13.6033210E+04  0.             74.4712087E+03  0.             15.2042255E+01  0.
      FZM            LM             MM             NM
-13.6795562E+04  0.             71.0768908E+03  0.
      VPCS
38.7489900E+02
      TFFS
 0.             0.

                                                          T(I)
                0.             0.
      SAC1
32.4453849E-03 26.7541211E-03-82.1863814E-03  0.              0.             64.1238157E-04  0.
      FLEX
      POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
      XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F
10.0000000E-01  0.            -26.5416480E-01  0.              0.            -24.0834772E+00-58.9189478E+00  0.
28.9911966E+01  0.              0.             55.4538986E-03 16.1042791E+00  0.              0.             34.2882570E-05
20.0000000E-01  0.            -22.2615572E-01  0.              0.            -10.3076658E+00-44.6917821E+00  0.
28.9544965E+01  0.              0.             82.3961353E-04 14.6048515E+00  0.              0.             14.0252533E-05
30.0000000E-01  0.            -92.3125719E-02  0.              0.             12.3014913E+00-19.4224719E+00  0.
28.3814481E+01  0.              0.            -15.7090954E-03 73.1888456E-01  0.              0.            -17.2638845E-05
40.0000000E-01  0.             10.1308155E-02  0.              0.            -27.1324010E+00-56.8088188E+00  0.
28.9911961E+01  0.              0.             42.1851667E-03 17.2858749E-01  0.              0.             36.9573755E-05
```

```
                                        SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                             GENERALIZED COMPUTER PROGRAM
                             INDSDF  2      CASE LROLL         STAGE  1      PAGE    169

                                                                 LANDING ROLL
                                        ISS =  1             ILR = 1        ICS = 0            IBS = 1
      AUTS

      TI                  TR

 17.1500000E-02 18.6500000E-01

                                                              PITCH AUTOPILOT

      DELQN            ALPHAE           ALPHD1           ALPCD1           ALPHET           DELQDE

 30.2996071E-01 21.1198852E-02-10.9101022E+00  0.                21.1198852E-02 80.0000000E-01

INTEG RTN.        HT =   1.00000000E-03
INTEG RTN.        HT =   1.00000000E-03
INTEG RTN.        HT =   1.00000000E-03
INTEG RTN.        HT =   1.00000000E-03

       2SDF

 20.5650000E-01 20.5650000E-01 60.0703576E+01  0.                69.9547834E-01 28.9899170E+01  0.              67.8998409E-01
  0.           -18.9938520E-02  0.           25.9743604E-02 28.9978676E+01 99.9143322E+00 28.9978625E+01  0.
 17.1288422E-02 13.4172967E-01  0.          -10.6202789E+00  0.           -33.8441128E-03  0.              13.0788544E-01
  0.             0.           -13.0968132E-01  0.           -30.8855599E+00 12.4671000E+04  0.               0.
  0.             0.

      LGEAR

      DELTA            P                P2               FT               SR               SF               AA               FC2

 82.5075408E-03 57.6468916E+03  0.              12.9594918E+03-68.5132220E-01-12.8106476E+03 30.1304118E+00-60.4249137E+02
 12.5212304E-02 23.5923018E+04  0.              60.7776679E+03 59.3134354E-01-60.0220776E+03 27.7832759E+00 28.8667262E+02
 12.5212304E-02 23.5923018E+04  0.              60.7776679E+03 59.3134354E-01-60.0220776E+03 27.7832759E+00 28.8667262E+02

      MUVP             VGPT             FTRX             FTRY             FTRZ             MA               MB               DDELTA

 33.6000000E-02 15.2903577E+01-43.2236635E+02  0.             -12.8541856E+03-41.7285206E+02  0.              82.5075408E-03
 47.9930051E-04 23.6202030E-03 29.1190209E+01  0.             -60.8001541E+03 29.2948327E+01  0.              12.5212304E-02
 47.9930051E-04 23.6202030E-03 29.1190209E+01  0.             -60.8001541E+03 29.2948327E+01  0.              12.5212304E-02

      SD2              SD1              S                S2D2             S2D1             S2               OMETD1           OMET

-88.9652835E-01 56.4653249E-01 56.7387168E-02  0.              0.              0.             -17.3668836E+02-14.0641650E+01
 15.4900152E-01-26.1233328E-02 14.6258418E-01  0.              0.              0.              37.5574778E+00-28.7141094E+01
 15.4900152E-01-26.1233328E-02 14.6258418E-01  0.              0.              0.              37.5574778E+00-28.7141094E+01

      FTRA             FTRB             FTRC             MTX              MTY              MTZ              FXM              FYM

-66.9869629E+01  0.             -13.4514828E+04  0.              98.3937677E+03  0.             -66.9869629E+01  0.
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

FZM	LM	MM	NM
-13.4690287E+04	0.	98.6282348E+03	0.

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.4485127E-03 27.4691120E-03-93.6175649E-03 0. 0. 67.2181673E-04 0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000009E-01	0.	-28.8901775E-01	0.	0.	35.1939558E-02	-34.2543156E+00	0.
28.9899171E+01	0.	0.	19.5466798E-02	14.9995007E+00	0.	0.	-89.0134018E-07
20.0000000E-01	0.	-24.2050626E-01	0.	0.	-50.0643431E-01	-39.0205357E+00	0.
28.9535118E+01	0.	0.	32.3234864E-03	13.4859777E+00	0.	0.	10.0952709E-06
30.0000009E-01	0.	-11.4589782E-01	0.	0.	[illegible]E-01	-2[illegible].2307[illegible]E+00	0.
28.99023[illegible]E+01	0.	0.	-44.5[illegible]E-03	6[illegible]E-01	0.	0.	-[illegible]7.0041415E-07
40.0[illegible]E-01	0.	-17.942436[illegible]E-02	0.	0.	-43.13971[illegible]E-01	-32.379[illegible]E+00	0.
28.[illegible]E+01	0.	0.	95.3[illegible]E-03	74.39[illegible]3741E-02	0.	0.	10.4439[illegible]E-06

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
17.1500000E-02	10.8500000E-01

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
30.2996071E-01	21.1198852E-02	-10.6202789E+00	0.	21.1198852E-02	80.0000000E-01

INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03

```
                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                       GENERALIZED COMPUTER PROGRAM
                              INDSOF  2      CASE LROLL        STAGE  1      PAGE     171
INTEG RTN.       HT =  1.00000000E-03
       2SDF
 20.7650000E-01 20.7650000E-01 60.6502726E+01  0.             69.9173809E-01 28.9879144E+01  0.             57.2764326E-01
  0.            -18.8004229E-02  0.            25.9705208E-02 28.9935724E+01 99.8847469E+00 28.9935651E+01  0.
 20.5662608E-02 11.3194445E-01  0.           -10.3600649E+00  0.           -40.6448536E-03  0.             10.9129839E-01
  0.              0.           -16.2337048E-01  0.           -30.1287103E+00 12.4671000E+04  0.              0.
  0.              0.
      LGEAR
      DELTA           P              P2             FT             SR             SF             AA             FC2
 87.3114972E-03 67.6201403E+03  0.            13.8625653E+03 48.5978510E-02-13.7619946E+03 20.3584438E+00-58.5902762E+02
 12.4101621E-02 23.1891817E+04  0.            60.0259992E+03-29.9572718E-01-58.9852791E+03 38.2675776E+00 28.8385239E+02
 12.4101621E-02 23.1891817E+04  0.            60.0259992E+03-29.9572718E-01-58.9852791E+03 38.2675776E+00 28.8385239E+02
      MUVP            VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA
 33.6000000E-02 11.9082227E+01-46.2903887E+02  0.           -13.7769014E+03-44.4667882E+02  0.             87.3114972E-03
 25.6048737E-04 15.4064008E-03 15.3731194E+01  0.           -60.0398173E+03 15.4830123E+01  0.             12.4101621E-02
 25.6048737E-04 15.4064008E-03 15.3731194E+01  0.           -60.0398173E+03 15.4830123E+01  0.             12.4101621E-02
      SD2             SD1            S              S2D2           S2D1           S2             OMETD1         OMET
-11.3237419E+00 65.4485283E-01 69.9345585E-02  0.             0.             0.           -18.5278284E+02-17.6550403E+01
 31.0368622E-01-26.1105686E-02 14.5734317E-01  0.             0.             0.            19.8500157E+00-28.6780422E+01
 31.0368622E-01-26.1105686E-02 14.5734317E-01  0.             0.             0.            19.8500157E+00-28.6780422E+01
      FTRA            FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM
-17.7141480E+02  0.           -13.3914564E+04  0.            12.7555187E+04  0.           -17.7141480E+02  0.
      FZM             LM             MM             NM
-13.3523511E+04  0.             13.1222538E+04  0.
       VPCS
 38.7489900E+02
       TFFS
  0.              0.
                                                             T(I)
                u.             0.
       SA31
```

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                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                      GENERALIZED COMPUTER PROGRAM

                          INDSOF  2      CASE LROLL        STAGE  1      PAGE    172

32.4521021E-03 28.1880774E-03-10.4661502E-02  0.               0.              70.0661611E-04  0.
     FLEX

     POINT             XD2F             XD2T             YD2F             YD2T             ZD2F             ZD2T             XD1F
     XD1T              YD1F             YD1T             ZD1F             ZD1T             XD0F             YD0F             ZD0F

10.0000000E-01  0.            -31.5112759E-01  0.               0.              24.2689248E+00-10.4969500E+00  0.
28.5879211E+01  0.              0.             52.2301538E-03 13.8013934E+00  0.               0.            -35.3758391E-05
20.0000000E-01  0.            -26.6152774E-01  0.               0.              23.2248886E-01-31.6869417E+00  0.
28.3518826E+01  0.              0.             17.8565110E-03 12.3413085E+00  0.               0.            -12.3720606E-05
30.0000000E-01  0.            -14.5844704E-01  0.               0.             -53.2098637E-01-35.1591917E+00  0.
28.5783310E+01  0.              0.            -24.4360635E-03 51.6952523E-01  0.               0.             16.1605977E-05
40.0000000E-01  0.            -49.7316068E-02  0.               0.              19.5122817E+00-71.0233374E-01  0.
28.9879210E+01  0.              0.             44.5400503E-03-30.6613815E-02  0.               0.            -34.6997634E-05
                                                          LANDING RCLL
     AUTS                          ISS =  1          ILR = 1          ICS = 0          IBS = 1

     TI               TR

17.1500000E-02 19.0500000E-01

                                                          PITCH AUTOPILCT

     DELON            ALPHAE           ALPHD1           ALPDD1           ALPHET           DELODE

30.2996071E-01 21.1198852E-02-10.3600649E+00  0.               21.1198852E-02 80.0000000E-01

INTEG RTN.       HT =   1.00000000E-03
INTEG RTN.       HT =   1.00000000E-03
INTEG RTN.       HT =   1.00000000E-03
INTEG RTN.       HT =   1.00000000E-03

     2SDF

20.9650000E-01 20.9650000E-01 61.2300990E+01  0.              69.8719070E-01 26.9851827E+01  0.              46.8824677E-01
 0.           -18.5590023E-02  0.             25.9664014E-02 28.9889740E+01 99.8530785E+00 28.9889632E+01  0.
25.0246551E-02 92.6657374E-02  0.            -10.1474090E+00  0.             -49.4599334E-03  0.              87.7196938E-02
 0.             0.            -19.7530480E-01  0.             -29.7503989E+00 12.4671000E+04  0.               0.
 0.             0.

     LGEAR

     DELTA            P                P2               FT               SR               SF               AA               FC2

94.0729946E-03 81.4199705E+03  0.              15.1553180E+03 45.9058588E-02-15.0628882E+03 18.7104970E+00-55.8924525E+02
12.3337345E-02 22.8237476E+04  0.              59.5113265E+03-31.8477173E-01-58.4677772E+03 38.3716099E+00 24.6329973E+02
12.3337345E-02 22.8237476E+04  0.              59.5113265E+03-31.8477173E-01-58.4677772E+03 38.3716099E+00 24.6329973E+02
```

```
                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                        GENERALIZED COMPUTER PROGRAM
           INOSDF  2      CASE LROLL        STAGE  1      PAGE     173
      MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 33.6000000E-02 83.4036734E+00-50.6671770E+02  0.                -15.0795170E+03-48.3285679E+02  0.                94.0729  6E-03
 62.6612895E-06 37.6391142E-05-37.2948590E-01  0.                -59.5192446E+03-37.5900007E-01  0.                12.3337345E-02
 62.6612895E-05 37.6991142E-05-37.2948990E-01  0.                -59.5182446E+03-37.5900007E-01  0.                12.3337345E-02

      SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

-13.0005739E+00 63.9239637E-01 82.8692371E-02  0.                 0.              0.              -20.1369033E+02-21.5200991E+01
 30.1660877E-01-24.1317294E-02 14.5243213E-01  0.                 0.              0.              -48.1923085E-02-28.6516473E+01
 30.1660877E-01-24.1317294E-02 14.5243213E-01  0.                 0.              0.              -48.1923085E-02-28.6516473E+01

      FTRA            FTRB            FTPC            MTX             MTY             MTZ             FXM             FYM

-30.2034956E+02  0.             -13.4177971E+04  0.               16.7992840E+04  0.              -30.2034956E+02  0.

      FZM             LM              MM              NM

-13.3767425E+04  0.              17.2127866E+04  0.

      VPCS

 38.7489900E+02
      TFFS

  0.              0.

                                                                 T(I)
                  0.             0.

      SAC1

 32.4564466E-03 28.9131995E-03-11.5357798E-02  0.                 0.             72.6884394E-04  0.

      FLEX

      POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

 10.0000000E-01  0.             -34.2554576E-01  0.                0.             24.6656369E+00-10.8567416E+00  0.
 28.3851893E+01  0.               0.            -52.2783315E-03 12.5544823E+00  0.               0.             -35.8349146E-05
 20.0000000E-01  0.             -29.1825456E-01  0.                0.             28.5144458E-01-31.7110637E+00  0.
 28.3496135E+01  0.               0.            -16.6392828E-03 11.1827179E+00  0.               0.             -12.7064017E-05
 30.0000000E-01  0.             -18.1644367E-01  0.                0.            -59.7117419E-01-35.3551078E+00  0.
 28.3757223E+01  0.               0.             21.2081636E-03 41.8262610E-01  0.               0.              16.4644383E-05
 40.0000000E-01  0.             -84.0269789E-02  0.                0.             20.5555105E+00-48.2081805E-01  0.
 28.9851893E+01  0.               0.            -57.6714873E-03-13.7016259E-01  0.               0.             -35.9042189E-05
                                                          LANDING ROLL
                      ISS =  1            ILR = 1             ICS = 0           IBS = 1
```

ORIGINAL PAGE IS
OF POOR QUALITY

AUTS

TI	TR
17.1500000E-02	19.2500000E-01

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELODE
30.2996071E-01	21.1198852E-02	-10.1474090E+00	0.	21.1198852E-02	80.0000000E-01

INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03

2SDF

21.0950000E-01	21.0950000E-01	51.6069349E+01	0.	69.8372602E-01	28.9830128E+01	0.	40.2420695E-01
0.	-18.3076860E-02	0.	25.9635638E-02	28.9858064E+01	99.8312685E+00	28.9857926E+01	0.
28.2436196E-02	79.5484105E-02	0.	-10.0674914E+00	0.	-55.8274975E-03	0.	73.9655385E-02
0.	0.	-21.1762258E-01	0.	-29.8966100E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
10.0098848E-02	93.5532400E+03	0.	16.3264091E+03	-18.7357226E+00	-16.1470707E+03	36.3033343E+00	-52.9202851E+02
12.2778257E-02	22.6091088E+04	0.	59.1312288E+03	19.9861663E+00	-58.7459559E+03	14.1665956E+00	16.1492012E+02
12.2778257E-02	22.6091088E+04	0.	59.1312288E+03	19.9861663E+00	-58.7459559E+03	14.1665956E+00	16.1492012E+02

MUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	59.0575100E+00	-54.6243561E+02	0.	-16.2572488E+03	-51.7739399E+02	0.	10.0098848E-02
18.1708322E-04	10.9313797E-03	10.7457838E+01	0.	-59.1375436E+03	10.8368193E+01	0.	12.2778257E-02
18.1708322E-04	10.9313797E-03	10.7457838E+01	0.	-59.1375436E+03	10.8368193E+01	0.	12.2778257E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
-14.6037073E+00	62.2011194E-01	91.0827927E-02	0.	0.	0.	-21.5724749E+02	-24.2252718E+01
19.0144285E-01	-19.5391352E-02	14.4947362E-01	0.	0.	0.	13.8933581E+00	-28.6347969E+01
19.0144285E-01	-19.5391352E-02	14.4947362E-01	0.	0.	0.	13.8933581E+00	-28.6347969E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
-35.1039625E+02	0.	-13.4588867E+04	0.	20.8377044E+04	0.	-35.1039625E+02	0.

FZM	LM	MM	NM
-13.5417020E+04	0.	20.5868653E+04	0.

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 175

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.4603099E-03 29.3889078E-03 -12.2135599E-02 0. 0. 74.2802727E-04 0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000000E-01	0.	-35.6607964E-01	0.	0.	-27.1273517E+00	-63.7228087E+00	0.
28.9830056E+01	0.	0.	24.6728290E-03	11.8857652E+00	0.	0.	38.9184925E-05
20.0000000E-01	0.	-29.9989824E-01	0.	0.	-15.0810211E+00	-50.5505162E+00	0.
28.9478049E+01	0.	0.	-10.4695913E-04	10.4671504E+00	0.	0.	16.9355485E-05
30.0000099E-01	0.	-19.4106629E-01	0.	0.	16.9833508E+00	-12.4847683E+00	0.
28.9736567E+01	0.	0.	-22.1334351E-04	35.0059562E-01	0.	0.	-20.4801567E-05
40.0000000E-01	0.	-10.3375440E-01	0.	0.	-33.3983104E+00	-58.2184596E+00	0.
28.9830043E+01	0.	0.	19.1476346E-03	-18.9552442E-01	0.	0.	42.9864828E-05

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
17.1500000E-02	19.3800000E-01

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
30.2996071E-01	21.1198852E-02	-10.0674914E+00	0.	21.1198852E-02	80.0000000E-01

STAGE ON--INCR. DELTA1

```
              PRINT      .05
              AMAXER     .01
              DELTS      .01
              INDSTF     1
                     TRA

    2SOF

21.0950000E-01 21.0950000E-01 61.6069349E+01  0.                 69.8372602E-01 28.9830128E+01  0.                40.2420695E-01
 0.            -18.3676860E-02  0.             25.9635638E-02     28.9858064E+01 99.8312685E+00 28.9857926E+01  0.
28.2436196E-02 79.5484105E-02  0.             -10.0674914E+00     0.            -55.8274975E-03  0.               73.9655385E-02
 0.             0.            -21.1762258E-01  0.                -29.8966100E+00 12.4671000E+04  0.                0.
 0.             0.

    LGEAR

    DELTA          P              P2             FT             SR             SF             AA             FC2

10.0098848E-02 93.5532400E+03  0.            16.3264091E+03-18.7357226E+00-16.1470707E+03 36.3033343E+00-52.9202851E+02
12.2778257E-02 22.6091088E+04  0.            59.1312288E+03 19.9861663E+00-58.7459559E+03 14.1665956E+00 16.1492012E+02
12.2778257E-02 22.6091088E+04  0.            59.1312288E+03 19.9861663E+00-58.7459559E+03 14.1665956E+00 16.1492012E+02

    HUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 59.0575100E+00-54.6243561E+02  0.            -16.2572488E+03-51.7739399E+02  0.             10.0098848E-02
18.1708322E-04 10.9313797E-03 10.7457838E+01  0.            -59.1379436E+03 10.8368193E+01  0.             12.2778257E-02
18.1708322E-04 10.9313797E-03 10.7457838E+01  0.            -59.1379436E+03 10.8368193E+01  0.             12.2778257E-02

    SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-14.6037073E+00 62.2011194E-01 91.0827927E-02  0.             0.             0.            -21.5724749E+02-24.2252718E+01
 19.3144285E-01-19.5391352E-02 14.4947362E-01  0.             0.             0.             13.8933581E+00-28.6347969E+01
 19.3144285E-01-19.5391352E-02 14.4947362E-01  0.             0.             0.             13.8933581E+00-28.6347969E+01

    FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

-35.1039625E+02  0.           -13.4588867E+04  0.             20.8377044E+04  0.            -35.1039625E+02  0.

    FZM            LM             MM             NM

-13.5417020E+04  0.            20.5868653E+04  0.

    VPCS

38.7489900E+02

    TFFS

 0.             0.
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T(I)

0.	0.

SAC1

32.4603099E-03	29.3889078E-03	-12.2135599E-02	0.	0.	74.2802727E-04	0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000000E-01	0.	-35.6607964E-01	0.	0.	-27.1273517E+00	-63.7228087E+00	0.
28.9830056E+01	0.	0.	24.6728290E-03	11.8857652E+00	0.	0.	38.9184925E-05
20.0000000E-01	0.	-29.9989824E-01	0.	0.	-15.0810211E+00	-50.5505162E+00	0.
28.9478049E+01	0.	0.	-10.4695913E-04	10.4671504E+00	0.	0.	16.9355485E-05
30.0000000E-01	0.	-19.4106629E-01	0.	0.	16.9833508E+00	-12.4847683E+00	0.
28.9736567E+01	0.	0.	-22.1334351E-04	35.0059562E-01	0.	0.	-20.4801567E-05
40.0000000E-01	0.	-10.3375440E-01	0.	0.	-33.3983104E+00	-58.2184596E+00	0.
28.9830049E+01	0.	0.	19.1476346E-03	-18.9552442E-01	0.	0.	42.9864828E-05

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
17.1500000E-02	19.3800000E-01

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELODE
30.2996071E-01	21.1198852E-02	-10.0674914E+00	0.	21.1198852E-02	80.0000000E-01

INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03

2SOF

21.5950000E-01	21.5950000E-01	63.0559132E+01	0.	69.6677134E-01	28.9743395E+01	0.	15.3994660E-01
0.	-17.1516415E-02	0.	25.9536575E-02	28.9747187E+01	99.7551641E+00	28.9747231E+01	0.
38.5446397E-02	30.4516381E-02	0.	-96.1839149E-01	0.	-76.2189912E-03	0.	22.8296709E-02
0.	0.	-15.0373746E-01	0.	-31.1259701E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM

                     INDSDF  2      CASE LROLL         STAGE  1      PAGE     178

      DELTA            P               P2              FT              SR              SF              AA              FC2

 14.2530236E-02 19.5920315E+04  0.              24.9482985E+03-30.1885993E+00-24.9521409E+03-77.7805192E-02-31.8374715E+02
 12.2876369E-02 22.0449682E+04  0.              59.2037088E+03 22.3974930E+00-58.6788961E+03 19.2975162E+00 23.4145977E+01
 12.2876369E-02 22.0449682E+04  0.              59.2037088E+03 22.3974930E+00-58.6788961E+03 19.2975162E+00 23.4145977E+01

      MUVP             VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 58.3249863E-03 35.0786305E-02-14.5478263E+02  0.             -24.9426999E+03-13.1714050E+02  0.              14.2530236E-02
 51.3042803E-05 30.8601245E-04 30.3743400E+00  0.             -59.2042999E+03 30.6286835E+00  0.              12.2876369E-02
 51.3042803E-05 30.8601245E-04 30.3743400E+00  0.             -59.2042999E+03 30.6286835E+00  0.              12.2876369E-02

      SD2              SD1             S               S2D2            S2D1            S2              OMETD1          OMET

-63.1401491E+00 48.2454540E-01 11.9895003E-01  0.              0.              0.             -54.8808542E+01-31.8469019E+01
 95.2126469E-01-74.4000396E-03 14.4142297E-01  0.              0.              0.              39.2675429E-01-28.6331068E+01
 95.2126469E-01-74.4000396E-03 14.4142297E-01  0.              0.              0.              39.2675429E-01-28.6331068E+01

      FTRA             FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

-82.2836951E+01  0.             -14.3355716E+04  0.              53.2655257E+04  0.             -82.2836951E+01  0.

      FZM              LM              MM              NM

-14.4164734E+04  0.              53.8760974E+04  0.

        VPCS

 38.7469900E+02

        TFFS

  0.              0.

                                                                     T(I)
                   0.                0.

        SAC1

 32.4743717E-03 31.2538629E-03-14.7115522E-02  0.              0.              79.6457465E-04  0.

        FLEX

      POINT            XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T             YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

 10.0000000E-01  0.             -27.4612015E-01  0.              0.             -26.2167508E+00-73.0208785E+00  0.
 28.3743323E+01  0.              0.             -36.9274855E-03 88.2114388E-01  0.              0.              38.9102387E-05
 20.0000000E-01  0.             -19.2787401E-01  0.              0.             -18.2883190E+00-62.3622625E+00  0.
 28.9414620E+01  0.              0.             -10.5082732E-03 75.4687034E-01  0.              0.              18.0193617E-05
 30.0000000E-01  0.             -12.3830630E-01  0.              0.              20.3211674E+00-97.7670605E-01  0.
```

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                                  SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                       GENERALIZED COMPUTER PROGRAM

                          INOSDF  2      CASE LROLL          STAGE  1       PAGE     179

28.9656030E+01  0.             0.              15.2965174E-03 10.6035893E-01  0.               0.             -21.9842279E-05
40.0000000E-01  0.          -54.1824241E-02  0.               0.           -30.9601261E+00-50.2050140E+00  0.
28.9743327E+01  0.             0.           -30.8043280E-03-40.3661411E-01  0.               0.              39.9646651E-05
                                                                 LANDING RCLL
                                        ISS =  1           ILR = 1        ICS = 0            IBS = 1
    AUTS

    TI              TR

17.1580000E-02 19.8800000E-01

                                                          PITCH AUTOPILOT

    DELON           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELODE

30.2996071E-01 21.1198852E-02-96.1839149E-01  0.              21.1198852E-02 60.0000000E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
                                 TIRE DEFLECTION EXCEEDED          DELTA(1) =    1.9869599E-01
INTEG RTN.      HT =  1.00000000E-03

    2SDF

21.8525000E-01 21.8525000E-01 63.8019525E+01  0.              69.5671454E-01 28.9699016E+01  0.              30.1086577E-02
 0.           -15.9006410E-02  0.             25.9493290E-02 28.9699173E+01 99.7219286E+00 28.9698918E+01  0.
38.4637672E-02 59.7061765E-03  0.            -94.3568651E-01  0.           -76.0714697E-03  0.             -16.3662593E-03
 0.             0.           -21.4311032E-01  0.            -33.7755465E+00 12.4671000E+04  0.              0.
 0.             0.

    LGEAR

    DELTA           P               P2              FT              SR              SF              AA              FC2

19.8695991E-02 32.1595919E+04  0.             37.1384926E+03-26.3298921E+00-37.1390942E+03-12.1775498E-02-13.1146395E+02
12.2825657E-02 21.9182934E+04  0.             59.1697989E+03 53.7279340E-01-58.5957646E+03 21.1074063E+00 31.9592393E-01
12.2825657E-02 21.9182934E+04  0.             59.1697989E+03 53.7279340E-01-58.5957646E+03 21.1074063E+00 31.9592393E-01

    MUVP            VGPT            FTRX            FTRY            FTRZ            MA       .      MB              DDELTA

85.4053381E-03 51.3727757E-02-31.7189221E+02  0.             -37.1392736E+03-26.9363656E+02  0.              19.8695991E-02
58.8920741E-05 35.4275912E-04 34.8463178E+00  0.             -59.1697921E+03 35.1398752E+00  0.              12.2825657E-02
58.8920741E-05 35.4275912E-04 34.8463178E+00  0.             -59.1697921E+03 35.1398752E+00  0.              12.2825657E-02

    SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

-58.6256666E+00 30.9645870E-01 13.0262802E-01  0.              0.              0.            -11.2234856E+02-33.9386571E+01
-56.5379931E-01-86.9216643E-04 14.3955645E-01  0.              0.              0.             45.0511220E-01-28.6342829E+01
-56.5379931E-01-86.9216643E-04 14.3955645E-01  0.              0.              0.             45.0511220E-01-28.6342829E+01

    FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM
```

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ORIGINAL PAGE IS OF POOR QUALITY

```
                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                         GENERALIZED COMPUTER PROGRAM

              INDSOF  2      CASE LROLL        STAGE  1      PAGE    180

-31.4661123E+02  0.        -15.5477965E+04  0.        94.5231037E+04  0.        -31.4661123E+02  0.
    FZM            LM            MM            NM
-15.6346368E+04  0.         95.3256969E+04  0.
     VPCS
34.7489900E+02
     TFFS
 0.              0.

                 0.              0.                     T(I)
     SAC1
32.4860544E-03 32.2420975E-03-15.9347387E-02  0.          0.          81.9844148E-04  0.
     FLEX
   POINT          XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
   XD1T           YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F
10.0000000E-01  0.         -31.9617414E-01  0.               0.          -19.5065357E+00-80.0713732E+00  0.
28.9698970E+01  0.           0.          -80.1873671E-03 70.0597800E-01   0.               0.          23.5701340E-05
20.0000000E-01  0.         -14.1394034E-01  0.               0.          -13.8503994E-01-57.2369207E+00  0.
29.3394237E+01  0.           0.          -39.9129658E-03 58.4044319E-01   0.               0.          10.0718484E-05
30.0000000E-01  0.         -17.6663599E-01  0.               0.           38.9070072E-01-24.1154039E+00  0.
29.3618009E+02  0.           0.           47.6987126E-03-10.1781436E-02   0.               0.         -12.8593255E-05
40.0000000E-01  0.         -12.9820258E-01  0.               0.          -17.1503523E+00-30.6246760E+00  0.
28.9698964E+01  0.           0.          -85.6368120E-03-49.2495219E-01   0.               0.          30.2730666E-05
                                              LANDING ROLL
                      ISS =  1           ILR = 1          ICS = 0          IBS = 1
   AUTS
    TI              TR
17.1500000E-02 20.1375000E-01
                                              PITCH AUTOPILOT
   DELON          ALPHAE          ALPHD1          ALPDD1          ALPHET          DELODE
30.2996071E-01 21.1198852E-02-94.3568651E-01  0.           21.1198852E-02 80.0000000E-01
```

ORIGINAL PAGE IS
OF POOR QUALITY

APPENDIX G

AIRPLANE B FLEXIBLE BODY EXAMPLE 4

```
STCASE TAB
ATAB01        2
ATAB02        2
ATAB09        2
ATAB10        2
ATAB11        2
ATAB12        2
ATAB15        2
ATAB16        2
ATAB51        2
ATAB52        2
ATAB53        2
ATAB56        2
ATAB57        2
CTAB01        13
CTAB02        13
FTAB02        5
FTAB03        20
TTAB10        50
VTAB01        5
VTAB02        5
VTAB03        5
VTAB04        5
VTAB06        5
       TRA
REM    BCD 3SDF2-PLANPLANE
NCASE  BCD 1LROLL
REM    BCD 4INTEGRATION INFORMATION
IVAROH        6
TMAX          400.
AMINER        .00005
PRTMIN        .0
AMAXER        .001
DELTS         .001
PRINT         .05
REM    BCD 3REQD FOR SDF-2
AMASS         3874.899
HGC7F         100.
GAM7D         -1.1500
VG77F         296.22076
THTBO         10.3394
RHHGR         .0
INDAPC        1
INDADD        1
INDFPA        1
INDPLA        1
INDACM        2
INDGRT        1
INDWGT        1
REM    BCD 5VEHICLE PHYSICAL PROP. DATA
INDVPC        1
XCGRF         .0
VTAB01        2,0.,0.,5000.,1.
VTAB02        2,0.,1.59702E+6,5000.,1.59702E+6
VTAB03        2,0.,1.59702E+6,5000.,1.59702E+6
VTAB04        2,0.,1.59702E+6,5000.,1.59702E+6
INDXZS        1
VTAB06        2,0.,1.0E+5,5000.,1.0E+5
REM    BCD 4AERODYNAMIC INPUT DATA
INDAER        1
AREFF         1605.
D1RFF         37.7
D2RFF         56.7
INDA01        1
ATAB01        -7.3573427E-3,-5.5941985E-3
```

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ORIGINAL PAGE IS
OF POOR QUALITY

```
ATAB02      1.4120979E-3,8.8931664E-4
INDA02      1
INDA03      1
ATAB03      4.18951E-2,2.10644E-2
INDA10      1
ATAB10      -3.978321E-2,-3.9650349E-2
INDA11      1
ATAB11      5.7452448E-2,3.7645688E-2
INDA12      1
ATAB12      1.4721279E-3,1.2354312E-3
INDA15      1
ATAB15      -1.725E-2,-1.45E-2
INDA16      1
ATAB16      1.25E-4,5.0E-5
INDA51      1
ATAB51      7.3516484E-3,1.7027972E-3
INDA52      1
ATAB52      -5.2147852E-4,1.0238928E-3
INDA53      1
ATAB53      -3.1368631E-4,1.8365268E-5
INDA56      1
ATAB56      8.7E-3,7.3418182E-3
INDA57      1
ATAB57      2.0E-5,3.6363636E-5
REM     BCD 3ENGINE THRUST DATA
INDTFF      3
INDTSO      1
IT10X       4
TTAB10      -2.,-1.5,-1.,-.5,0.,.5,1.,1.5,2.
TTAB10      0.,.1,.2,.3                                                         13
TTAB10      0.,0.,0.,0.,0.                                                      14
TTAB10      0.,0.,0.,0.                                                         19
TTAB10      0.,0.,0.,0.,0.                                                      23
TTAB10      0.,0.,0.,0.                                                         28
TTAB10      0.,0.,0.,0.,0.                                                      32
TTAB10      0.,0.,0.,0.                                                         37
TTAB10      0.,0.,0.,0.,0.                                                      41
TTAB10      0.,0.,0.,0.                                                         46
IT10H       9
REM     BCD 3LANDING GEAR DATA
NSTRUT      3
MASS        4.941000,27.19587,27.19587
RX          35.1833,-2.83867,-2.83867
RY          0.,-8.3333,+8.3333
RZ          1.91667,.519583,.519583
THETAD      0.,0.,0.
ERDEG       0.
RGR         4.47
NTIRES      2.,3.,3.
RZERO       1.0479167,1.13125,1.13125
W           .554167,.604167,.604167
DELTAM      .1958333,.1958333,.19583333
RLT         1.5E+3
IFO         1
AI          1.324533E+5,3.8129286E+5,3.8129286E+5
BI          1.2112257,1.412391,1.412391
FTAB02      2,0.,0.,1.5E+4,0.
FTAB03      6,0.,0.,.07,.336,.1,.336,.4,.336,1.,.336,100.,.336
MOMENT      1.2,2.6,2.6
MB          0.,0.,0.
RF          5.48333,6.8792,6.8792
VZ          0.
PZERO       35280.,40320.,40320.
VZERO       1.1614583,.4716435,.4716435
A           .1104166,.2673611,.2673611
```

```
IL                1
INDC01            1
NSMAIN            2
CTAB01            0.,-.6667,1.,2.,3.
CTAB01            136.781,136.781,443.92,443.92,443.92,443.92,443.92            6
CTAB01            443.92                                                        13
INDC02            1
CTAB02            0.,1.6667,1.,2.,3.
CTAB02            136.781,136.781,4.23E+4,4.23E+4,4.23E+4,4.23E+4               6
CTAB02            4.23E+4,4.23E+4                                               12
MUS               .1,.1,.1
ES                .0.1333,.0.16667,.0016667
SB                1.333,1.6667,1.6667
REM       BCD 4FLEXIBLE AIRFRAME DATA
INDFLX            1
NMODE             4
GMASS1            66.6617,79.4557,70.8341,18.1131
GFREQ             13.188,16.512,30.059,43.398
SZMOD             .03,-.10,-.10,-.02,-.0042,-.0042
SZMOD             -.153,.1393,.1393,-.065,.0112,.0112               7
ARMODE            0.,0.,-.0114,0.,-4.239E-4,0.
ARMODE            0.,0.,-.0414,0.,3.643E-4,0.                       7
ARMODE            0.,0.,.0435,0.,-6.03E-4,0.                        13
ARMODE            0.,0.,.0646,0.,-3.034E-5,0.                       19
NPTS              4
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,.1970,-.0385,.0035,.0035
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,.0830,-.0200,-.153,-.065   13
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,-.100,-.0042,.1393,.0112   25
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,.2330,-.2440,-.1272,-.125  37
ROIS              42.5667,0.,0.,35.0833,0.,1.91667
ROIS              -2.83867,8.3333,.539583,-32.3333,0.,0.             7
REM       BCD 3PLOT TAPE DATA
IPLT              0
REM       BCD 3AUTOPILOT DATA
REM       BCD 3A. ENGINE DATA
INDAUT            1
IN                2
ZN                -.55,-.55
YN                -14.1667,14.1667
N                 0.,0.
REM       BCD 3B. DRAG CHUTE DATA
ICS               0
COCH              .244
SSH               16.5.
XCH               -3.625
YCH               0.
ZCH               -2.41667
REM       BCD 5C. PHASE BEGIN-TERMINATE
ITO               0
HF                12.25
NF                0
XRF               0.
HRF               8.796
DELTAH            3.
NLRI              0
TI                0.
KP                0
VS                1.0
XS                3000.
TS                12.
HS                0.
REM       BCD 4G. HOLD MANEUVER DATA
ALPDES            11.5
TTD               0.
KE        INT 1,1
```

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ORIGINAL PAGE IS
OF POOR QUALITY

```
RM               1.5
REM       BCD 5H. LANDING ROLL MANEUVER DATA
TSP              0.
TRV              0.
TCH              7.
TBK              0.
ISS              0.
ILR              0
IBS              0
REM       BCD 5I. ENGINE FAILURE STAGE DATA
IC        INT 0,0
XRF1             0.
IT1       INT 0,0
XRF2             0.
IT2       INT 0,0
H1               0.
IH1       INT 0,0
H2               0.
IH2       INT 0,0
HR1              0.
IHR1      INT 0,0
HR2              0.
IHR2      INT 0,0
TR1              0.
ITR1      INT 0,0
TR2              0.
ITR2      INT 0
REM       BCD 5J. BRAKE COND.STAGE DATA
IB        INT 0,0,0
TBK1             1.
IBK1      INT 0,0,0
TBK2             1.
IBK2      INT 0,0,0
REM       BCD 4K. PITCH AUTOPILOT DATA
TST              .2
ALPDL            2.
RFALPH           0.
DELALA           .01
PSH              0.
PSH2             0.
RFALP2           0.
DELQF            8.
DELQTO           0.
DELQL            -10.
DELQU            +25.
DELFO1           5.25
REM       BCD 4L. YAW AUTOPILOT DATA
RFB              .5
DELBA            .05
PSR              10.
OPSIA            .05
RFPSI            .5
PSPSI            0.
DELRL            -20.
DELRU            +20.
REM       BCD 4M. ROLL AUTOPILOT DATA
RFPHI            .5
OPHIA            .05
PSA              -10.
DELPL            -12.
DELPU            +12.
REM       BCD 5N.THROTTLE AUTOPILOT DATA
TF        INT 0,0
NDF              0.,0.
IR        INT 0,0
```

ORIGINAL PAGE IS OF POOR QUALITY

```
NB              1.,1.
NLR             0.,0.
NTO             0.,0.
K2              1.
REM      BCD 40. BRAKE AUTOPILOT DATA
MBC             0.,..,0.
PO              .1
DELTAW          ...1
OMECD1          2..
MBL             0.,0.,0.
MBU             3.,..,0.
REM      BCD 9P. CONTROL RESPONSE DATA
DELHS           5.25
DELRPD          31.5
DELA            10.
NED1            .1
REM      BCD 40. INITIALIZATION
IAP             3
HR              1..
DELQD           4.56478
DELQPE          4.56478
DELQN           4.56478
DELPD           0.
DELRD           0.
MANLOG          1
PITCHP          1
REM      BCD 2STAGING DATA
REM      BCD 44.GEARS INTO PROGRAM
INDLG           0
ISTAGE          0
DECRES   BCD 1HR
STESTD          11..
         TRA
INDLG           -1
REM      BCD 40.SMOOTH IMPACT STAGE
AINCRS   BCD 3DDELT1DDELT2DDELT3
STEST           -.05,-..5,-..5
         TRA
PRINT           ..2
DELTS           ..05
AMAXER          ..0.5
PRTMIN          ..
AINCRS   BCD 1TIMES
STEST           .9
         TRA
ATAB51          7.3516484E-3,1.7.27972E-3
ATAB52          -5.2147852E-4,1..238928E-3
ATAB53          -3.1368631E-4,1.8.65268E-5
ATAB56          0.,0.
ATAB57          0.,..
REM      BCD 50. EFFICIENT AMAXER STAGE
AINCRS   BCD 4DELTA1DELTA2DELTA3
STEST           .1,.1,.1
         TRA
PRINT           .05
AMAXER          ..1
DELTS           ..1
REM      BCD 40.SMOOTH IMPACT STAGE
AINCRS   BCD 1DDELT1
STEST           -.05
         TRA
PRINT           ..2
DELTS           ..05
AMAXER          ..005
REM      BCD 5E. EFFICIENT AMAXER STAGE
```

```
AINCRS BCD 1DELTA1
STEST      .1
      TRA
PRINT      .05
AMAXER     .01
DELTS      .01
INDSTF     1
      TRA
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 7

A.GEARS INTO PROGRAM

INITIAL PRINT OUT FOR VPCS

XCGRF	AREFF	D1RFF	D2RFF
0.	16.0500000E+02	37.7000000E+00	56.7000000E+00

PRINT CODES IDENTIFYING TIME HISTORY

2SDF

TIME	TIMES	XG77F	YG77F	HGC7F	U777F	V777F	W777F
PI77R	QI77R	RI77R	AMACH	VA77F	DYNPP	XG77F1	YG77F1
ZG77F1	ALPHD	BETAD	ALPHD1	BETAD1	GAM7D	SIG7D	THTPD
PSIPD	PHIPD	AX77F	AY77F	AZ77F	WTR7P	FDC	FCX
FCY	FCZ						

VPCS

AMASS

TFFS

NT	NT

SAC1

CAVAM	CA	CN	CY	CL	CM	CNN

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                INDSOF  2     CASE LROLL        STAGE  1     PAGE      8

      2SDF

  0.             0.             0.                   0.             10.0000000E+00 29.0274042E+01  0.                 59.0569126E+00
  0.             0.             0.              26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00   0.                   0.              0.           -11.6059853E-01  0.                 10.3393988E+00
  0.             0.            57.7454851E-01   0.             -31.6515539E+00 12.4671000E+04  0.                  0.
  0.             0.

      VPCS

38.7489900E+02
      TFFS

  0.             0.

                                                     T(I)
             0.                 0.
      SAC1

29.7745819E-03-20.8749533E-03 60.9750569E-02  0.              0.              15.3281670E-03  0.
                                                     FLARE
    AUTS
    ALPDES          PHIDES          TTD

11.5000000E+00  0.              0.
                                                 PITCH AUTOPILOT
    DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

26.8544760E-01-14.0024531E-07  0.              0.             -14.0024531E-07 26.8544760E-01
INTEG RTN.      HT =  1.00000000E-03
      2SDF

  0.             0.             0.                   0.             10.0000000E+00 29.0274042E+01  0.                 59.0569126E+00
  0.             0.             0.              26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00   0.                   0.              0.           -11.6059853E-01  0.                 10.3393988E+00
  0.             0.            90.1422983E-02   0.             -26.3302709E+00 12.4671000E+04  0.                  0.
  0.             0.

      VPCS

38.7489900E+02
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 9

TFFS

0. 0.

T(I)

0. 0.

SAC1

29.7745819E-03-20.8749533E-03 60.9750569E-02 0. 0. 15.3281670E-03 0.

FLARE

AUTS

ALPDES	PHIDES	TTD
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
27.5607208E-01	-14.0024531E-07	0.	0.	-14.0024531E-07	27.5607208E-01

STAGE ON--DECR. HR

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

                   INOSDF  2      CASE LROLL         STAGE  1      PAGE      10

              INDLG        -1
              REM      BCD 4B.SMOOTH IMPACT STAGE
              AINCRS   BCD 300ELT100ELT200ELT3
              STEST        -.05,-.05,-.05
                       TRA

      2SDF

 0.              0.              0.              0.              10.0000000E+00 29.0274042E+01  0.             59.0569126E+00
 0.              0.              0.           26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00    0.              0.              0.           -11.6059853E-01  0.             10.3393988E+00
 0.              0.           90.1422983E-02     0.          -26.3302709E+00 12.4671000E+04  0.              0.
 0.              0.

     LGEAR

     DELTA            P               P2              FT              SR              SF              AA              FO2

 0.              35.2800000E+03  0.              0.              31.9713310E-01-38.9549765E+02-78.8562277E+01  0.
 0.              40.3200000E+03  0.              0.              54.9315280E-01-10.7799996E+03-39.6383699E+01  0.
 0.              40.3200000E+03  0.              0.              54.9315280E-01-10.7799996E+03-39.6383699E+01  0.

     MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

33.6000000E-02 29.6159990E+01  0.              0.              -0.              0.              0.             -79.6895154E-01
33.6000000E-02 29.6159990E+01  0.              0.              -0.              0.              0.             -10.9046626E-01
33.6000000E-02 29.6159990E+01  0.              0.              -0.              0.              0.             -10.9046626E-01

     SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

 0.              0.              0.              0.              0.              0.              0.              0.
 0.              0.              0.              0.              0.              0.              0.              0.
 0.              0.              0.              0.              0.              0.              0.              0.

     FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

 0.              0.              0.              0.              0.              0.              0.              0.

     FZM             LM              MM              NM

 0.              0.              0.              0.

      VPCS

38.7489900E+02

      TFFS

 0.              0.
```

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```
                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                          GENERALIZED COMPUTER PROGRAM
               INDSOF  2     CASE LROLL        STAGE  1     PAGE     11

                                                           T(I)
            0.                0.
     SAC1

29.7745819E-03-28.8749533E-03 60.9750569E-02  0.            0.            15.3281678E-03  0.
     FLEX

     POINT         XD2F          XD2T          YD2F          YD2T          ZD2F          ZD2T          XD1F
     XD1T          YD1F          YD1T          ZD1F          ZD1T          XD0F          YD0F          ZD0F

10.0000000E-01  0.             90.1259752E-02  0.             0.             0.            -28.9135646E+00  0.
29.0274042E+01  0.              0.             0.             59.0569126E+00 0.              0.            -22.8850454E-04
20.0000000E-01  0.             10.1738888E-01  0.             0.             0.            -28.4544208E+00  0.
29.0274042E+01  0.              0.             0.             59.0569126E+00 0.              0.            -13.3138408E-04
30.0000000E-01  0.             93.2368094E-02  0.             0.             0.            -26.1584011E+00  0.
29.0274042E+01  0.              0.             0.             59.0569126E+00 0.              0.             15.1869517E-04
40.0000000E-01  0.             90.1270639E-02  0.             0.             0.            -24.3726223E+00  0.
29.0274042E+01  0.              0.             0.             59.0569126E+00 0.              0.            -25.1618033E-04
                                                              FLARE
     AUTS

     ALPDES        PHIDES        TTD

11.5000000E+00  0.             0.
                                                        PITCH AUTOPILOT
     DELON         ALPHAE        ALPHD1        ALPDD1        ALPHET        DELQDE

27.5339224E-01-14.0024531E-07  0.            0.            -14.0024531E-07 27.5339224E-01

INTEG RTN.     HT =  8.00000000E-04
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
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INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
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INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
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INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
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INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03

    2SDF

50.0000000E-03 50.0000000E-03 14.8031852E+00 0.                            96.9255675E-01 29.0027316E+01 0.                            59.3319886E+00
0.             27.2363829E-04 0.                           26.5170101E-02  29.6034000E+01 10.4122497E+01 29.5967086E+01             0.
62.9389619E-01 11.5616896E+00 0.                           12.6451556E-01  0.             -12.1824054E-01 0.                            10.3434483E+00
0.             0.             94.7824027E-02 0.                            -26.7932210E+00 12.4671000E+04 0.                           0.
0.             0.

   LGEAR

   DELTA          P              P2             FT             SR             SF             AA             FC2

0.             35.2800000E+03 0.             0.             31.5281571E-01-38.9549765E+02-78.8562277E+01 0.
0.             40.3200000E+03 0.             0.             50.0377502E-01-10.7799996E+03-39.6383699E+01 0.
0.             40.3200000E+03 0.             0.             50.0377502E-01-10.7799996E+03-39.6383699E+01 0.

   MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

                  INDSDF  2      CASE LROLL        STAGE  1      PAGE      13

33.6000000E-02 29.5969707E+01  0.          0.          -0.          0.          0.          -76.6535562E-01
33.6000000E-02 29.5988319E+01  0.          0.          -0.          0.          0.          -78.1421176E-02
33.6000000E-02 29.5988319E+01  0.          0.          -0.          0.          0.          -78.1421176E-02
     SD2            SD1            S            S2D2          S2D1          S2          OMETD1        OMET

 0.             0.             0.           0.            0.            0.          0.            0.
 0.             0.             0.           0.            0.            0.          0.            0.
 0.             0.             0.           0.            0.            0.          0.            0.
     FTRA           FTRB           FTRC         MTX           MTY           MTZ         FXM           FYM

 0.             0.             0.           0.            0.            0.          0.            0.
     FZM            LM             MM           NM

-42.4553664E-02  0.          -28.2129265E-01  0.
     VPCS

38.7489900E+02
     TFFS

 0.             0.

                                                     T(I)
                0.             0.
     SAC1

30.0142492E-03-21.9770041E-03 62.1246449E-02  0.            0.          12.2577435E-03  0.
     FLEX

     POINT          XD2F           XD2T          YD2F          YD2T          ZD2F          ZD2T          XD1F
     XD1T           YD1F           YD1T          ZD1F          ZD1T          XD0F          YD0F          ZD0F

10.0000000E-01  0.          94.7399983E-02  0.             0.          -70.7375463E-04-28.8634615E+00  0.
29.0027310E+01  0.           0.          -18.0259180E-05 59.2155997E+00  0.            0.           -22.0358789E-04
20.0000000E-01  0.          10.4017920E-01  0.             0.          -86.4746805E-04-28.4983508E+00  0.
29.0032533E+01  0.           0.          -25.4280067E-05 59.2361801E+00  0.            0.           -13.3584997E-04
30.0000000E-01  0.          97.2561171E-02  0.             0.           86.0862860E-04-28.6473508E+00  0.
29.0028708E+01  0.           0.           24.5483221E-05 59.3399656E+00  0.            0.            15.2296063E-04
40.0000000E-01  0.          94.7940137E-02  0.             0.          -11.6694376E-03-25.2413997E+00  0.
29.0027309E+01  0.           0.          -32.9847765E-05 59.4197230E+00  0.            0.           -25.2189725E-04
                                                     FLARE
     AUTS
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INOSDF 2 CASE LROLL STAGE 1 PAGE 14

ALPDES	PHIDES	TTO
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
28.3042261E-01	61.6896066E-03	12.6451556E-01	0.	61.6896066E-03	28.3042261E-01

```
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
```

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                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                       GENERALIZED COMPUTER PROGRAM

                         INDSDF  2      CASE LROLL        STAGE  1      PAGE      15
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
    2SDF

10.0000000E-02 10.0000000E-02 29.5966729E+00  0.                            93.7100961E-01 28.9775565E+01  0.                            59.6188276E+00
 0.            48.1970865E-04  0.                           26.5000397E-02 29.5844871E+01 10.3990475E+01 29.5772845E+01  0.
65.6392934E-01 11.6257341E+00  0.                           12.9187211E-01  0.                           -12.7132816E-01  0.           10.3544047E+00
 0.             0.                            99.5792456E-02  0.                           -27.2803983E+00 12.4671000E+04  0.             0.
 0.             0.

    LGEAR

    DELTA            P                P2               FT               SR               SF               AA               FC2

 0.            35.2800000E+03  0.               0.               31.1245471E-01-38.9549765E+02-78.8562277E+01  0.
 0.            40.3200000E+03  0.               0.               44.7795803E-01-10.7799996E+03-39.6383699E+01  0.
 0.            40.3200000E+03  0.               0.               44.7795803E-01-10.7799996E+03-39.6383699E+01  0.
    HUVP             VGPT             FTRX             FTRY             FTRZ             MA               MB               DDELTA

33.6000000E-02 29.5776613E+01  0.               0.              -0.               0.               0.              -73.5068539E-01
33.6000000E-02 29.5809666E+01  0.               0.              -0.               0.               0.              -45.9570722E-02
33.6000000E-02 29.5809666E+01  0.               0.              -0.               0.               0.              -45.9570722E-02
    SO2              SO1              S                S2O2             S2O1             S2               OMETD1           OMET

 0.             0.               0.               0.               0.               0.               0.               0.
 0.             0.               0.               0.               0.               0.               0.               0.
 0.             0.               0.               0.               0.               0.               0.               0.
    FTRA             FTRB             FTRC             MTX              MTY              MTZ              FXM              FYM

 0.             0.               0.               0.               0.               0.               0.               0.
    FZM              LM               MM               NM

-35.6504747E-02  0.             -20.5186175E-01   0.
    VPCS

38.7489900E+02
    TFFS
```

```
 0.             0.

                  0.                 0.                        T(I)
     SAC1

30.2764712E-03-23.1185515E-03 63.3345971E-02  0.              0.              90.5479575E-04  0.

     FLEX

     POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
     XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.              99.4715497E-02  0.              0.             -11.9553940E-03-28.8144834E+00  0.
28.9775555E+01  0.              0.             -67.3748694E-05 59.4117128E+00  0.              0.             -22.2383148E-04
20.0000000E-01  0.              10.6329964E-01  0.              0.             -55.7195737E-04-28.5376076E+00  0.
28.9784797E+01  0.              0.             -65.7138716E-05 59.4482792E+00  0.              0.             -13.5932157E-04
30.0000000E-01  0.              10.1409948E-01  0.              0.              70.7894062E-04-27.1720620E+00  0.
28.9778029E+01  0.              0.              68.3612632E-05 59.6323928E+00  0.              0.              15.4653598E-04
40.0000000E-01  0.              99.6443108E-02  0.              0.             -11.9452926E-03-26.1388568E+00  0.
28.9775553E+01  0.              0.             -96.6191198E-05 59.7728985E+00  0.              0.             -25.5428502E-04
                                                                FLARL
     AUTS

     ALPDES          PHIDES          TTD

11.5000000E+00  0.              0.
                                                         PITCH AUTOPILCT

     DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

29.1249392E-01 12.5734134E-02 12.9187211E-01  0.              12.5734134E-02 29.1249392E-01
```

```
2SQF

62.1000000E-02 62.1000000E-02 18.2779110E+01  0.              72.8272249E-01 28.8806318E+01  0.                47.6357052E+00
 0.           -56.4265994E-03  0.            26.2189114E-02 29.2708473E+01 10.1803475E+01 29.2704376E+01  0.
-15.4858293E-01 93.6603669E-01 0.           -71.2729499E-01  0.            30.3127164E-02  0.                96.6916313E-01
 0.             0.            66.6362576E-01  0.            -51.6734069E+00 12.4671000E+04  0.                0.
 0.             0.

LGEAR

 DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.            -13.7733708E+00-38.9549765E+02-78.8562277E+01  0.
12.7645174E-02 27.4921410E+04  0.            61.2687173E+03-23.6429745E+00-60.0230698E+03 45.8028190E+00 12.2436086E+03
12.7645174E-02 27.4921410E+04  0.            61.2687173E+03-23.6429745E+00-60.0230698E+03 45.8028190E+00 12.2436086E+03

 MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 29.2578985E+01  0.             0.            -0.             0.             0.            -48.3602669E-01
30.4092281E-03 18.5297585E-02 18.9982668E+02  0.            -62.4753341E+03 19.0667523E+02  0.            12.7645174E-02
30.4092281E-03 18.5297585E-02 18.9982668E+02  0.            -62.4753341E+03 19.0667523E+02  0.            12.7645174E-02

 SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

 0.             0.             0.             0.             0.             0.             0.             0.
-95.5709199E-01-53.8002798E-02 15.0535070E-01  0.             0.             0.            24.4445542E+01-29.1620405E+01
-95.5709199E-01-53.8002798E-02 15.0535070E-01  0.             0.             0.            24.4445542E+01-29.1620405E+01

 FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

24.7322454E+03  0.            -12.2537435E+04  0.            -19.8457137E+04  0.            24.7322454E+03  0.

 FZM            LM             MM             NM

-12.2866338E+04  0.            -19.8660393E+04  0.

 VPCS

38.7489900E+02

 TFFS

 0.             0.

                                                             T(I)
               0.             0.

 SAC1

32.1718773E-03-66.6749403E-04 47.3336211E-02  0.             0.             17.5664726E-03  0.
```

```
                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                         GENERALIZED COMPUTER PROGRAM

              INDSOF  2      CASE LROLL        STAGE  1      PAGE     61

     FLEX

     POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

 10.0000000E-01  0.              65.5268978E-01  0.              0.             -16.5121023E-01-50.9080784E+00  0.
 28.8805994E+01  0.               0.            -22.1861114E-02 49.8213808E+00  0.              0.             57.4981987E-04
 20.0000000E-01  0.              64.7498952E-01  0.              0.              42.0178821E-01-45.4906880E+00  0.
 28.8698370E+01  0.               0.            -27.6628803E-02 49.3387077E+00  0.              0.            -35.9712350E-04
 30.0000000E-01  0.              66.1300747E-01  0.              0.             -35.2395110E-01-55.3597559E+00  0.
 28.8777422E+01  0.               0.             27.3391948E-02 47.7489206E+00  0.              0.             25.2143858E-04
 40.0000000E-01  0.              68.0873241E-01  0.              0.              18.1657989E-01-51.6881070E+00  0.
 28.8806191E+01  0.               0.            -37.2921386E-02 45.4383256E+00  0.              0.             22.5461521E-04

                                                          LANDING ROLL
                                   ISS =  1        ILR = 1          ICS = 0         IBS = 1
     AUTS

     TI             TR

 17.1000000E-02 45.0000000E-02

                                                     PITCH AUTOPILOT

     DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE

 30.2904551E-01 21.0562305E-02-71.2729499E-01  0.             21.0562305E-02 43.4154551E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

     2SOF

 64.1000000E-02 64.1000000E-02 18.8632797E+01  0.              73.1720146E-01 28.8876189E+01  0.             46.9789513E+00
  0.           -57.1559507E-03  0.             26.2155824E-02 29.2671273E+01 10.1777498E+01 29.2665267E+01  0.
-18.7493988E-01 92.3695293E-01  0.            -57.4033255E-01  0.             36.7057615E-02  0.             96.0408937E-01
  0.              0.             56.6626939E-01  0.            -44.4350986E+00 12.4671000E+04  0.              0.
  0.              0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

  0.             35.2800000E+03  0.              0.            -50.3846829E-01-38.9549765E+02-78.8562277E+01  0.
 10.8040762E-02 26.2146127E+04  0.             48.2893088E+03-18.7230470E+00-47.1486008E+03 41.9441613E+00 21.8830661E+03
 10.8040762E-02 26.2146127E+04  0.             48.2893088E+03-18.7230470E+00-47.1486008E+03 41.9441613E+00 21.8830661E+03

     HUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA
```

```
                                     SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM
                              INDSOF  2      CASE LROLL        STAGE  1      PAGE     62

33.6000000E-02 29.2556581E+01  0.             0.               -0.            0.             0.             -40.3416436E-01
46.7146987E-03 28.4648073E-02 23.0631456E+02  0.               -49.3659847E+03 23.5984237E+02 0.              10.8040762E-02
46.7146987E-03 28.4648073E-02 23.0631456E+02  0.               -49.3659847E+03 23.5984237E+02 0.              10.8040762E-02
     SD2            SD1             S             S2D2             S2D1           S2             OMETD1          OMET

  0.             0.             0.             0.               0.             0.             0.             0.
-85.0194669E-01-71.9338843E-02 14.9274246E-01  0.               0.             0.             30.2543893E+01-28.6099297E+01
-85.0194669E-01-71.9338843E-02 14.9274246E-01  0.               0.             0.             30.2543893E+01-28.6099297E+01
     FTRA           FTRB            FTRC          MTX              MTY            MTZ            FXM             FYM

21.0201992E+03  0.            -96.5786176E+03  0.              -14.5350149E+04 0.             21.0201992E+03  0.
     FZM            LM              MM            NM

-96.7518145E+03  0.           -14.4513744E+04  0.
      VPCS

38.7489900E+02
      TFFS

 0.             0.

                                                            T(I)
                0.                  0.
      SAC1

32.1397969E-03-57.3016907E-04 46.1739396E-02  0.               0.             19.1022904E-03  0.
      FLEX
     POINT          XD2F            XD2T           YD2F            YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F            YD1T           ZD1F            ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.             55.5512953E-01  0.               0.            -85.6221840E-02-44.5733393E+00  0.
28.8876130E+01  0.              0.           -24.7228712E-02 49.1703784E+00  0.              0.             10.3160164E-04
20.0000000E-01  0.             55.3780864E-01  0.               0.             70.8809723E-01-36.7628925E+00  0.
28.8767100E+01  0.              0.           -15.9799290E-02 48.8243714E+00  0.              0.            -80.5824531E-04
30.0000000E-01  0.             56.4680386E-01  0.               0.            -59.6046248E-01-50.4449940E+00  0.
28.8846658E+01  0.              0.            17.5349157E-02 46.9920536E+00  0.              0.             70.9051283E-04
40.0000000E-01  0.             58.0647899E-01  0.               0.             49.7240865E-01-40.0067841E+00  0.
28.8876451E+01  0.              0.           -30.1855626E-02 44.8290552E+00  0.              0.            -45.9903966E-04
                                                           LANDING ROLL
                                        ISS =  1         ILR = 1          ICS = 0          IBS = 1
      AUTS
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

               INOSDF  2      CASE LROLL        STAGE  1      PAGE      63

     TI              TR

 17.1000000E-02 47.0000000E-02

                                                 PITCH AUTOPILOT

     DELQN          ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

 30.2904551E-01 21.0562305E-02-57.4033255E-01  0.             21.0562305E-02 44.4654551E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

       2SDF

 66.1000000E-02 66.1000000E-02 19.4485748E+01  0.             73.5668916E-01 28.8023767E+01  0.             46.4726086E+00
  0.           -57.0831102E-03  0.            26.2125517E-02 29.2637398E+01 10.1753821E+01 29.2630235E+01  0.
-20.4744324E-01 91.3760574E-01  0.           -41.8943859E-01  0.             40.0874906E-02  0.             95.3848003E-01
  0.              0.            44.2405808E-01  0.           -36.6295715E+00 12.4671000E+04  0.              0.
  0.              0.

     LGEAR

     DELTA          P              P2              FT              SR              SF              AA              FC2

  0.            35.2800000E+03  0.              0.             15.5663885E-01-38.9549765E+02-78.8562277E+01  0.
 84.4716219E-03 24.7555819E+04  0.             33.9887449E+03-11.0681952E+00-33.0135471E+03 35.8583052E+00 32.3567053E+03
 84.4716219E-03 24.7555819E+04  0.             33.9887449E+03-11.0681952E+00-33.0135471E+03 35.8583052E+00 32.3567053E+03

     MUVP           VGPT           FTRX            FTRY            FTRZ            MA              MB              DDELTA

 33.6000000E-02 29.2544172E+01  0.              0.             -0.              0.              0.            -48.3437452E-01
 69.4045752E-03 42.2823076E-02 24.2027139E+02  0.            -34.8719287E+03 25.3348777E+02  0.             84.4716219E-03
 69.4045752E-03 42.2823076E-02 24.2027139E+02  0.            -34.8719287E+03 25.3348777E+02  0.             84.4716219E-03

     SO2            SO1            S               S2D2            S2D1            S2              OMETD1          OMET

  0.              0.             0.              0.              0.              0.              0.              0.
-69.3906943E-01-87.4605015E-02 14.7675115E-01  0.              0.              0.             32.4806124E+01-27.9759330E+01
-69.3906943E-01-87.4605015E-02 14.7675115E-01  0.              0.              0.             32.4806124E+01-27.9759330E+01

     FTRA           FTRB           FTRC            MTX             MTY             MTZ             FXM             FYM

 16.3308719E+03  0.            -67.9774897E+03  0.            -91.1973747E+03  0.             16.3308719E+03  0.

     FZM            LM             MM              NM

-68.0518879E+03  0.            -90.0487775E+03  0.
```

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.1021752E-03-49.7145925E-04 45.2378074E-02 0. 0. 20.5073651E-03 0.

FLEX

POINT / XD1T	XD2F / YD1F	XD2T / YD1T	YD2F / ZD1F	YD2T / ZD1T	ZD2F / XD0F	ZD2T / YD0F	XD1F / ZD0F
10.0000000E-01	0.	43.1405729E-01	0.	0.	93.1216294E-03	-37.5039720E+00	0.
28.8923997E+01	0.	0.	-25.5056622E-02	48.6530979E+00	0.	0.	-40.2296530E-04
20.0000000E-01	0.	43.5428973E-01	0.	0.	72.5646112E-01	-30.1749146E+00	0.
28.8314916E+01	0.	0.	-11.4629069E-03	48.4638095E+00	0.	0.	-97.7647354E-04
30.0000000E-01	0.	44.3941309E-01	0.	0.	-62.2838733E-01	-42.7952486E+00	0.
28.8894145E+01	0.	0.	49.5960439E-03	46.3601645E+00	0.	0.	93.4888925E-04
40.0000000E-01	0.	45.5085783E-01	0.	0.	58.1095085E-01	-30.0854216E+00	0.
28.8924312E+01	0.	0.	-18.9711787E-02	44.4372115E+00	0.	0.	-95.4270896E-04

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI TR

17.1000000E-02 49.0000000E-02

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELODE
30.2904551E-01	21.0562305E-02	-41.8943859E-01	0.	21.0562305E-02	45.5154551E-01

```
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
```

2SDF

```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                  GENERALIZED COMPUTER PROGRAM
                         INDSOF  2     CASE LROLL         STAGE  1      PAGE      65

 68.1000000E-02 68.1000000E-02 20.0338011E+01  0.              73.9806348E-01 28.8945357E+01  0.              46.1213827E+00
  0.           -56.2673687E-03  0.             26.2094874E-02 29.2603147E+01 10.1729880E+01 29.2595857E+01  0.
-20.6540383E-01 90.6903218E-01  0.            -27.0104488E-01  0.             40.4439562E-02  0.             94.7347042E-01
  0.             0.             31.1047128E-01  0.            -29.3802070E+00 12.4671000E+04  0.              0.
  0.             0.

    LGEAR

    DELTA          P              P2             FT             SR             SF             AA             FC2

  0.            35.2800000E+03  0.              0.            50.8993891E-01-38.9549765E+02-78.8562277E+01  0.
 59.3699438E-03 23.2387705E+04  0.             20.5367965E+03-18.3524632E-01-19.7584608E+03 28.6196270E+00 41.8045881E+03
 59.3699438E-03 23.2387705E+04  0.             20.5367965E+03-18.3524632E-01-19.7584608E+03 28.6196270E+00 41.8045881E+03

    HUVP           VGPT           FTRX           FTRY           FTRZ           HA             HB             DDELTA

 33.6000000E-02 29.2529022E+01  0.              0.             -0.             0.             0.            -48.3402621E-01
 10.5045531E-02 63.9888709E-02 22.2614815E+02  0.            -21.1922215E+03 23.8616380E+02  0.             59.3699438E-03
 10.5045531E-02 63.9888709E-02 22.2614815E+02  0.            -21.1922215E+03 23.8616380E+02  0.             59.3699438E-03

    SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.             0.             0.              0.             0.             0.             0.             0.
-49.5082768E-01-99.4126820E-02 14.5799768E-01  0.             0.             0.            30.5918436E+01-27.3382876E+01
-49.5082768E-01-99.4126820E-02 14.5799768E-01  0.             0.             0.            30.5918436E+01-27.3382876E+01

    FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

 11.3676696E+03  0.            -41.0735930E+03  0.            -44.2983869E+03  0.            11.3676696E+03  0.

    FZM            LM             MM             NM

-41.1296618E+03  0.            -43.5717616E+03  1.

      VPCS

 38.7489500E+02

      TFFS

  0.             0.

                                                    T(I)
                 0.             0.

      SAC1

 32.8620812E-03-43.8576472E-04 44.5328318E-02  0.             0.            21.7765091E-03  0.

      FLEX
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                     INDSDF  2      CASE LROLL        STAGE  1      PAGE      66

      POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.              30.1022046E-01  0.              0.              11.1609250E-01-30.6812592E+00  0.
28.8945866E+01  0.              0.             -24.2988720E-02 48.2791369E+00  0.              0.             -90.3760999E-04
20.0000000E-01  0.              31.0285774E-01  0.              0.              47.2555612E-01-26.6482506E+00  0.
28.8838000E+01  0.              0.              11.2232404E-02 48.2076601E+00  0.              0.             -86.8377466E-04
30.0000000E-01  0.              31.6352106E-01  0.              0.             -43.4668785E-01-33.5676925E+00  0.
28.8916168E+01  0.              0.             -59.2987243E-03 45.9023595E+00  0.              0.              91.8868697E-04
40.0000000E-01  0.              32.2977225E-01  0.              0.              42.6570401E-01-23.2827640E+00  0.
28.8946046E+01  0.              0.             -85.5451789E-03 44.2165278E+00  0.              0.             -12.2431556E-03

                                                                  LANDING ROLL
                                ISS =  1          ILR = 1            ICS = 0           IBS = 1
      AUTS

      TI             TR

17.1000000E-02 51.0000000E-02

                                                               PITCH AUTOPILOT

      DELON          ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

30.2904551E-01 21.0562305E-02-27.0104488E-01  0.              21.0562305E-02 46.5654551E-01

INTEG RTN.       HT =  1.00000000E-03
INTEG RTN.       HT =  1.00000000E-03
INTEG RTN.       HT =  1.00000000E-03
INTEG RTN.       HT =  1.00000000E-03

      2SDF

70.1000000E-02 70.1000000E-02 20.6189565E+01  0.              74.3841292E-01 28.8941098E+01  0.              45.9077102E+00
 0.           -54.8628651E-03  0.              26.2061042E-02 29.2565336E+01 10.1703471E+01 29.2558837E+01  0.
-19.5010532E-01 90.2784131E-01  0.             -14.7967032E-01  0.              30.1910347E-02  0.              94.0975132E-01
 0.              0.              19.2815667E-01  0.             -23.6696851E+00 12.4671000E+04  0.              0.
 0.              0.

      LGEAR

      DELTA           P               P2              FT              SR              SF              AA              FC2   .

 0.              35.2800000E+03  0.              0.              58.2440808E-01-38.9549765E+02-78.6562277E+01  0.
35.6124928E-03 21.7647084E+04  0.              98.7090159E+02 71.9457304E-01-92.7879364E+02 21.7719805E+00 48.5702127E+03
35.6124928E-03 21.7647084E+04  0.              98.7090159E+02 71.9457304E-01-92.7879364E+02 21.7719805E+00 48.5702127E+03

      MUVP           VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

33.6000000E-02 29.2500585E+01  0.              0.             -0.              0.              0.             -48.3164983E-01
17.0336068E-02 10.3751425E-01 17.5381094E+02  0.             -10.2961807E+03 19.2154105E+02  0.              35.6124928E-03
```

```
17.8336868E-02 10.3751425E-01 17.5381094E+02  0.              -10.2961807E+03 19.2154105E+02  0.              35.6124928E-03
     SD2            SD1              S              S2D2            S2D1            S2           OMETD1          OMET

 0.             0.             0.             0.              0.              0.              0.             0.
-27.7452443E-01-10.7155987E-01 14.3726832E-01  0.              0.              0.              24.6351417E+01-26.7793627E+01
-27.7452443E-01-10.7155987E-01 14.3726832E-01  0.              0.              0.              24.6351417E+01-26.7793627E+01
     FTRA           FTRB            FTRC            HTX             HTY             HT2             FXM            FYM

68.2714937E+02  0.             -19.7418032E+03  0.             -11.5154201E+03  0.              68.2714937E+02  0.
     FZM            LM              MM              NM

-19.8355667E+03  0.             -11.6689320E+03  0.
     VPCS

38.7489900E+02
     TFFS

 0.             0.

                                                                    T(I)
                   0.              0.
     SAC1

32.0224504E-03-39.4686348E-04 44.0341199E-02  0.              0.              22.9234748E-03  0.
     FLEX

     POINT          XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
     XD1T           YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.              18.2175117E-01  0.              0.              20.9102745E-01-25.0357766E+00  0.
28.8941844E+01  0.              0.             -21.0716236E-02 48.0378114E+00  0.              0.             -13.6072333E-03
20.0000000E-01  0.              19.5908962E-01  0.              0.              59.8591028E-02-25.9195283E+00  0.
28.8836250E+01  0.              0.              16.6804512E-02 47.9992851E+00  0.              0.             -57.5484668E-04
30.0000000E-01  0.              19.9121464E-01  0.              0.             -11.0259732E-01-24.5438097E+00  0.
28.8912738E+01  0.              0.             -11.5103488E-02 45.6368692E+00  0.              0.              73.3579884E-04
40.0000000E-01  0.              20.2748362E-01  0.              0.              13.8410579E-01-19.6657362E+00  0.
28.8941827E+01  0.              0.             -28.0889446E-03 44.1057238E+00  0.              0.             -13.2825042E-03
                                                                LANDING ROLL
                                  ISS =  1          ILR = 1          ICS = 0          IBS = 1
     AUTS

     TI             TR
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                         INDSOF  2      CASE LROLL        STAGE  1      PAGE      60
17.1000000E-02 53.0000000E-02

                                                     PITCH AUTOPILOT
   DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELODE

30.2904551E-01 21.0562305E-02-14.7967032E-01  0.              21.0562305E-02 47.6154551E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
     2SDF

72.1000000E-02 72.1000000E-02 21.2040327E+01  0.              74.7542945E-01 28.8914125E+01  0.              46.7973422E+00
 0.           -53.0863490E-03  0.             26.2021718E-02 29.2521397E+01 10.1672814E+01 29.2516230E+01  0.
-17.3868925E-01 90.0732048E-01  0.           -64.4496734E-02  0.             34.0557391E-02  0.             93.4787725E-01
 0.             0.             94.8981542E-02  0.            -20.0342280E+00 12.4671000E+04  0.              0.
 0.             0.

   LGEAR

   DELTA           P               P2              FT              SR              SF              AA              FC2

 0.            35.2800000E+03  0.              0.             50.0121961E-01-38.9549765E+02-78.8562277E+01  0.
15.9190494E-03 20.4009804E+04  0.             30.9238079E+02 14.2182114E+00-26.3525381E+02 16.8086910E+00 51.7546643E+03
15.9190494E-03 20.4009804E+04  0.             30.9238079E+02 14.2182114E+00-26.3525381E+02 15.8086910E+00 51.7546643E+03
   HUVP            VGPT            FTRX            FTRY            FTRZ            HA              HB              DDELTA

33.6000000E-02 29.2453501E+01  0.              0.             -0.              0.              0.             -48.2685057E-01
30.9166907E-02 18.8296542E-01 10.2088510E+02  0.             -33.0205166E+02 11.3862475E+02  0.             15.9190494E-03
30.9166907E-02 18.8296542E-01 10.2088510E+02  0.             -33.0205166E+02 11.3862475E+02  0.             15.9190494E-03
   SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

 0.             0.             0.              0.              0.              0.              0.              0.
-71.9837553E-02-11.0612591E-01 14.1542292E-01  0.              0.              0.             14.5977532E+01-26.3800210E+01
-71.9837553E-02-11.0612591E-01 14.1542292E-01  0.              0.              0.             14.5977532E+01-26.3800210E+01
   FTRA            FTRB            FTRC            HTX             HTY             HTZ             FXH             FYH

30.8735009E+02  0.            -61.8476158E+02  0.             31.7818191E+02  0.             30.8735009E+02  0.
   FZH             LH              HH              NH

-63.2892699E+02  0.            21.2847142E+02  0.
     VPCS
```

```
38.7489900E+02
      TFFS
 0.            0.

                                                               T(I)
        0.               0.
      SAC1
31.9856835E-03-36.1465821E-04 43.6925211E-02  0.              0.              23.9759425E-03  0.
      FLEX
     POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.             84.4159485E-02  0.              0.             28.8599596E-01-21.1458176E+00  0.
28.8915045E+01  0.              0.            -16.0538312E-02 47.9018232E+00  0.              0.            -17.3463346E-03
20.0000000E-01  0.             10.1490814E-01  0.              0.            -34.2081308E-01-26.7475141E+00  0.
28.8812513E+01  0.              0.             13.6949432E-02 47.7967359E+00  0.              0.            -25.8240768E-04
30.0000000E-01  0.             10.1610754E-01  0.              0.             22.4307192E-01-17.5266277E+00  0.
28.8886805E+01  0.              0.            -10.2747246E-02 45.5439003E+00  0.              0.             50.4503111E-04
40.0000000E-01  0.             10.4182485E-01  0.              0.            -12.4058721E-01-18.2454004E+00  0.
28.8914655E+01  0.              0.            -28.3688291E-03 44.0525165E+00  0.              0.            -13.7588172E-03
                                                          LANDING ROLL
                              ISS =  1         ILR = 1             ICS = 0          IBS = 1
     AUTS
     TI             TR
17.1000000E-02 55.0000000E-02

                                                      PITCH AUTOPILOT
     DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE
30.2904551E-01 21.0562305E-02-64.4496734E-02  0.             21.0562305E-02 48.6654551E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
      2SOF
74.1000000E-02 74.1000000E-02 21.7890152E+01  0.             75.0760205E-01 28.8867936E+01  0.             45.7495777E+00
 0.           -51.1846291E-03  0.             26.1974188E-02 29.2468303E+01 10.1635813E+01 29.2464591E+01  0.
-14.7335364E-01 89.9949525E-01  0.           -20.2652544E-02  0.             28.8637872E-02  0.             92.8813269E-01
```

G-27

ORIGINAL PAGE IS
OF POOR QUALITY

```
                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                          GENERALIZED COMPUTER PROGRAM

           INDSDF  2      CASE LROLL        STAGE  1     PAGE     78
 0.             0.          19.4616585E-02  0.            -18.4348846E+00 12.4671000E+04  0.             0.
 0.             0.
    LGEAR
    DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.            42.0910053E-01-38.9549765E+02-78.8562277E+01  0.
22.7350573E-04 19.1824278E+04  0.            19.7117005E+01 18.0079330E+00 20.2133557E+01 14.6805586E+00 51.4780641E+03
22.7350573E-04 19.1824278E+04  0.            19.7117005E+01 18.0079330E+00 20.2133557E+01 14.6805586E+00 51.4780641E+03
    MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 29.2387335E+01  0.             0.            -0.             0.             0.            -48.1984096E-01
33.6000000E-02 39.4362741E-01 71.0134318E+00  0.            -21.1349499E+01 80.1724953E+00  0.            22.7350573E-04
33.6000000E-02 39.4362741E-01 71.0134318E+00  0.            -21.1349499E+01 80.1724953E+00  0.            22.7350573E-04
    SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

 0.             0.             0.             0.             0.             0.             0.             0.
93.6319448E-02-11.0316613E-01 13.9327536E-01  0.             0.             0.            10.2785250E+00-26.2409724E+01
93.6319448E-02-11.0316613E-01 13.9327536E-01  0.             0.             0.            10.2785250E+00-26.2409724E+01
    FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

20.8388145E+01  0.            -39.4234010E+01  0.            29.1390079E+01  0.            20.8388145E+01  0.
    FZM            LM             MM             NM

-55.5344764E+01  0.           -12.4452784E+02  0.
      VPCS

38.7489900E+02
      TFFS

 0.             0.

                                                        T(I)
                 0.             0.
      SAC1

31.9534011E-03-33.4547018E-04 43.4495910E-02  0.             0.            24.9669689E-03  0.
      FLEX

    POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
    XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F
```

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                            GENERALIZED COMPUTER PROGRAM

                 INDSDF  2      CASE LROLL         STAGE  1      PAGE      71

10.0000000E-01  0.             90.8816942E-03  0.              0.             33.9660769E-01-19.1071411E+00  0.
28.8868956E+01  0.             0.             -97.1753056E-03 47.8362816E+00  0.             0.             -19.9405308E-03
20.0000000E-01  0.             28.1179494E-02  0.              0.            -57.5817940E-01-27.5437667E+00  0.
28.8769866E+01  0.             0.              41.3794566E-03 47.5866828E+00  0.             0.             -72.0753294E-05
30.0000000E-01  0.             25.4400544E-02  0.              0.             44.2194227E-01-13.7435706E+00  0.
28.8841668E+01  0.             0.             -33.2791408E-03 45.5710022E+00  0.             0.              36.1168418E-04
40.0000000E-01  0.             28.4786366E-02  0.              0.            -22.9601776E-01-17.6474718E+00  0.
28.8868687E+01  0.             0.             -67.0176127E-03 44.0275921E+00  0.             0.             -14.6772842E-03

                                                  LANDING ROLL
                     ISS =  1          ILR = 1             ICS = 0           IBS = 1
     AUTS

     TI               TR

17.1000000E-02 57.0000000E-02

                                              PITCH AUTOPILOT

     DELQW          ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

30.2904551E-01 21.0562305E-02-20.2652544E-02  0.              21.0562305E-02 49.7154551E-01

INTEG RTN.        HT =   1.00000000E-03
INTEG RTN.        HT =   1.00000000E-03
INTEG RTN.        HT =   1.00000000E-03
INTEG RTN.        HT =   1.00000000E-03
```

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                                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM

                              INDSDF  2      CASE LROLL        STAGE  1      PAGE     168

                                                               LANDING ROLL
                                    ISS =  1          ILR = 1          ICS = 0           IBS = 1
       AUTS

       TI              TR

   17.1000000E-02 18.6500000E-01

                                                                 PITCH AUTOPILOT

       DELQN            ALPHAE            ALPHD1            ALPDD1            ALPHET            DELCDE

   30.2904551E-01 21.0562305E-02-11.2001149E+00  0.                 21.0562305E-02 80.0000000E-01

INTEG RTN.         HT =   2.50000000E-04
INTEG RTN.         HT =   2.50000000E-04
INTEG RTN.         HT =   2.50000000E-04
INTEG RTN.         HT =   1.00000000E-03
         2SDF

   20.5600000E-01 20.5600000E-01 60.0558263E+01  0.                69.8582643E-01 28.9890420E+01  0.              68.8864251E-01
    0.           -18.9545803E-02  0.             25.9737925E-02 28.9972256E+01 99.9099364E+00 28.9972169E+01  0.
   22.3968586E-02 13.6125877E-01  0.            -11.0690466E+00  0.            -44.2537658E-03  0.              13.1700469E-01
    0.             0.            -13.4296059E-01  0.              -33.2703044E+00 12.4671000E+04  0.               0.
    0.             0.
       LGEAR

       DELTA            P                P2               FT               SR               SF               AA               FC2

   80.5768843E-03 57.7573627E+03  0.             12.5937250E+03-21.8992598E-01-12.4574103E+03 27.5940712E+00-56.8886435E+02
   13.2145748E-02 24.2445669E+04  0.             65.5906532E+03-24.0574809E-01-64.6653364E+03 34.0241660E+00 27.2831998E-03
   13.2145748E-02 24.2445669E+04  0.             65.5906532E+03-24.0574809E-01-64.6653364E+03 34.0241660E+00 27.2831998E-03
       MUVP             VGPT             FTRX             FTRY             FTRZ             MA               MB               DDELTA

   33.6000000E-02 15.1919634E+01-42.0016480E+02  0.               -12.5004905E+03-40.6298664E+02  0.              80.5768843E-03
   66.7951319E-05 40.1944847E-04 43.8236129E+00  0.               -65.6089922E+03 43.7843580E+00  0.              13.2145748E-02
   66.7951319E-05 40.1944847E-04 43.8236129E+00  0.               -65.6089922E+03 43.7843580E+00  0.              13.2145748E-02
       SD2              SD1              S                S2D2             S2D1             S2               OMETD1           OMET

  -67.6135543E-01 64.4911174E-01 56.9067789E-02  0.                0.               0.           -16.9291110E+02-14.1374776E+01
  -54.7082747E-02-80.3114502E-05 14.7069520E-01  0.                0.               0.            56.1337923E-01-28.9106680E+01
  -54.7082747E-02-80.3114502E-05 14.7069520E-01  0.                0.               0.            56.1337923E-01-28.9106680E+01
       FTRA             FTRB             FTPC             MTX              MIY              MTZ              FXM              FYM

  -80.5199431E+01  0.              -14.3775031E+04  0.               57.1514116E+03  0.            -80.5199431E+01  0.
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 169

FZH	LM	MM	NM
-14.3764578E+04	0.	58.6658510E+03	0.

VPCS

34.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.4579[illegible]5E-03 27.4118354E-03-92.5789338E-03 0. 0. 66.9564147E-04 0.

FLEX

POINT / XO1T	XO2F / YO1F	XO2T / YO1T	YO2F / ZO1F	YO2T / ZO1T	ZO2F / XO0F	ZO2T / YO0F	XO1F / ZO0F
10.0000000E-01	0.	-27.8100931E-01	0.	0.	73.2466986E-02	-35.1866044E+00	0.
28.9891650E+01	0.	0.	-25.1302864E-02	14.7246336E+00	0.	0.	-64.9008256E-04
20.0000000E-01	0.	-23.8441773E-01	0.	0.	11.6181687E-01	-34.3553352E+00	0.
28.9527936E+01	0.	0.	-26.4528194E-02	13.2740066E+00	0.	0.	-42.8610081E-04
30.0000000E-01	0.	-13.1235292E-01	0.	0.	-14.5895315E-01	-34.5713398E+00	0.
28.9742892E+01	0.	0.	27.2550735E-02	66.2313526E-01	0.	0.	49.5494215E-04
40.0000000E-01	0.	-41.3389721E-03	0.	0.	88.0249904E-02	-30.3827694E+00	0.
28.9891859E+01	0.	0.	-37.0449874E-02	38.9551328E-02	0.	0.	-75.8785089E-04

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 2

AUTS

TI	TR
17.1000000E-02	18.8500000E-01

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHO1	ALPOO1	ALPHET	DELQDE
30.2904551E-01	21.0562305E-02	-11.0690466E+00	0.	21.0562305E-02	80.0000000E-01

INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03

```
INTEG RTN.      HT =  1.00000000E-03

        2SOF

 20.7600000E-01 20.7600000E-01 60.6357278E+01  0.              69.8153584E-01 28.9871610E+01  0.             57.7521068E-01
  0.            -18.8131124E-02  0.            25.9699296E-02 28.9929135E+01 99.8802363E+00 28.9929061E+01  0.
 20.6439997E-02 11.4137229E-01  0.           -10.9094654E+00  0.            -40.7963984E-03  0.             11.0057562E-01
  0.             0.            -15.7390292E-01  0.            -32.8715348E+00 12.4671000E+04  0.              0.
  0.             0.

      LGEAR

      DELTA          P              P2             FT             SR             SF             AA             FC2

 85.3360411E-03 67.3985421E+03  0.            13.4842700E+03 62.3100504E-02-13.3532419E+03 26.5239060E+00-54.8689690E+02
 13.1761197E-02 24.1933709E+04  0.            65.3259927E+03-45.9633301E-01-64.3828685E+03 34.6789490E+00 16.7765392E+01
 13.1761197E-02 24.1933709E+04  0.            65.3259927E+03-45.9633301E-01-64.3828685E+03 34.6789490E+00 16.7765392E+01

      MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             ODELTA

 33.6000000E-02 11.8984584E+01-45.0248757E+02  0.           -13.4002606E+03-43.3400746E+02  0.             85.3360411E-03
 11.5232725E-04 69.3338436E-04 75.2924778E+00  0.           -65.3394927E+03 75.2539885E+00  0.             13.1761197E-02
 11.5232725E-04 69.3338436E-04 75.2924778E+00  0.           -65.3394927E+03 75.2539885E+00  0.             13.1761197E-02

      SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-50.2105806E-01 63.3359826E-01 69.6837200E-02  0.             0.             0.           -18.0583644E+02-17.6282871E+01
-20.8544849E-01-62.9768601E-03 14.7007438E-01  0.             0.             0.            96.4794725E-01-28.8963624E+01
-20.8544849E-01-62.9768601E-03 14.7007438E-01  0.             0.             0.            96.4794725E-01-28.8963624E+01

      FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

-15.8369952E+02  0.           -14.4136255E+04  0.            85.3734572E+03  0.           -15.8369952E+02  0.

      FZM            LM             MM             NM

-14.4072155E+04  0.            87.2904808E+03  0.

        VPCS

 38.7489900E+02

        TFFS

  0.             0.

                                                          T(I)
                 0.             0.

        SAC1
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                                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                               GENERALIZED COMPUTER PROGRAM

                                  INDSDF  2      CASE LROLL          STAGE  1      PAGE    171

32.4623042E-03 28.1646597E-03-10.4164804E-02  0.             0.             69.9576766E-04  0.

     FLEX

     POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.             -29.9912126E-01  0.             0.             14.8415603E-01-34.8490321E+00  0.
28.9873737E+01  0.               0.            -22.8072991E-02 13.5740718E+00  0.               0.            -11.3079475E-03
20.0000000E-01  0.             -25.8268568E-01  0.             0.             42.4099548E-01-31.5447702E+00  0.
28.9512738E+01  0.               0.            -20.7745407E-02 12.1677258E+00  0.               0.            -91.1066712E-04
30.0000000E-01  0.             -15.1183179E-01  0.             0.            -41.0533432E-01-36.7645967E+00  0.
28.9773877E+01  0.               0.             21.4069933E-02 54.5523835E-01  0.               0.             99.0841672E-04
40.0000000E-01  0.             -31.0750644E-02  0.             0.             40.4297015E-01-26.2052852E+00  0.
28.9874353E+01  0.               0.            -31.8800895E-02-62.6490357E-02  0.               0.            -14.5846683E-03
                                                        LANDING RCLL
                                ISS =  1          ILR = 1          ICS = 0          IBS = 1
     AUTS

     TI             TR

17.1000000E-02 19.0500000E-01
                                                      PITCH AUTOPILOT

     DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE

30.2904551E-01 21.0562305E-02-10.9094654E+00  0.             21.0562305E-02 80.0000000E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
     2SDF

20.9600000E-01 20.9600000E-01 61.2155413E+01  0.             69.7750789E-01 28.9846382E+01  0.             46.8069213E-01
 0.            -18.6223648E-02  0.             25.9659019E-02 28.9884173E+01 99.8492722E+00 28.9884106E+01  0.
19.8096676E-02 92.5181794E-02  0.            -10.6964896E+00  0.            -39.1535454E-03  0.             88.6027865E-02
 0.              0.            -18.0076757E-01  0.            -32.3472855E+00 12.4671000E+04  0.              0.
 0.              0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

92.3189464E-03 80.6403649E+03  0.             14.8144553E+03 19.2100755E-01-14.6920229E+03 24.7838947E+00-53.1558808E+02
13.0631892E-02 24.0503275E+04  0.             64.5392323E+03-54.6726326E-01-63.6038389E+03 34.3946861E+00 57.8276817E+01
13.0631892E-02 24.0503275E+04  0.             64.5392323E+03-54.6726326E-01-63.6038389E+03 34.3946861E+00 57.8276817E+01
```

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                 GENERALIZED COMPUTER PROGRAM

                       INDSOF  2      CASE LROLL        STAGE  1      PAGE     172
     MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 33.6000000E-02 84.2040648E+00-49.5251720E+02  0.              -14.7396345E+03-47.3261431E+02  0.              92.3189464E-03
 29.8840476E-04 17.9786570E-03 19.2901328E+01  0.              -64.5499333E+03 19.3020562E+01  0.              13.0631892E-02
 29.8840476E-04 17.9786570E-03 19.2901328E+01  0.              -64.5499333E+03 19.3020562E+01  0.              13.0631892E-02
     SD2             SD1             S               S2D2            S2D1            S2              OMETDI          OMET

-54.6525076E-01 62.3394221E-01 82.2526807E-02  0.               0.              0.             -19.7192263E+02-21.3960995E+01
-32.4273026E-01-11.6922396E-02 14.6832580E-01  0.               0.              0.              24.7462259E+00-28.8614233E+01
-32.4273026E-01-11.6922396E-02 14.6832580E-01  0.               0.              0.              24.7462259E+00-28.8614233E+01
     FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

-23.4190824E+02  0.             -14.3892920E+04  0.              13.2102839E+04  0.             -23.4190824E+02  0.
     FZM             LM              MM              NM

-14.3822027E+04  0.              13.4466675E+04  0.
     VPCS

 38.7489900E+02
     TFFS

  0.             0.

                                                                 T(I)
                 0.                 0.

     SAG1

 32.4663981E-03 28.9276047E-03-11.5433597E-02  0.               0.             72.7244510E-04  0.
     FLEX

     POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
     XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

 10.0000000E-01  0.             -32.1093557E-01  0.               0.             21.9722225E-01-34.9114062E+00  0.
 28.9849273E+01  0.               0.            -19.1209170E-02 12.4350315E+00  0.               0.            -15.5248707E-03
 20.0000000E-01  0.             -27.6678548E-01  0.               0.             60.7885252E-01-30.2490948E+00  0.
 28.9491737E+01  0.               0.            -10.1763998E-02 11.1122683E+00  0.               0.            -12.2679171E-03
 30.0000000E-01  0.             -16.8663246E-01  0.               0.            -55.9463843E-01-37.6374850E+00  0.
 28.9749019E+01  0.               0.             11.4683733E-02 42.6674837E-01  0.               0.             13.2463200E-03
 40.0000000E-01  0.             -60.2424231E-02  0.               0.             63.2080283E-01-22.4094949E+00  0.
 28.9850102E+01  0.               0.            -21.2864052E-02-15.5339702E-01  0.               0.            -19.9783512E-03
                                                          LANDING ROLL
                             ISS =  1          ILR = 1           ICS = 0          IBS = 1
```

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                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM
                          INDSDF  2      CASE LROLL        STAGE  1      PAGE     173
   AUTS

   TI             TR

17.1000000E-02 19.2500000E-01

                                                       PITCH AUTOPILOT

   DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE

30.2904551E-01 21.0562305E-02-10.6964896E+00  0.            21.0562305E-02 80.0000000E-01

INTEG RTN.     HT =  1.00000000E-03
INTEG RTN.     HT =  1.00000000E-03
INTEG RTN.     HT =  1.00000000E-03
INTEG RTN.     HT =  1.00000000E-03

    2SDF

21.1225000E-01 21.1225000E-01 61.6865721E+01  0.            69.7428317E-01 28.9820790E+01  0.            38.0997490E-01
 0.           -18.4135362E-02  0.            25.9624672E-02 28.9845832E+01 99.8228702E+00 28.9845762E+01  0.
20.0298634E-02 75.3165115E-02  0.           -10.4671402E+00  0.           -39.5934277E-03  0.            71.3578731E-02
 0.             0.           -20.3138247E-01  0.           -31.7834531E+00 12.4671000E+04  0.             0.
 0.             0.

   LGEAR

   DELTA          P              P2             FT             SR             SF             AA             FC2

10.0110762E-02 95.6647080E+03  0.            16.3263697E+03 13.2461524E-01-16.2171679E+03 22.1056180E+00-51.2816563E+02
12.8999996E-02 23.8626118E+04  0.            63.4056455E+03-48.5601011E-01-62.4837480E+03 33.8984384E+00 12.0940879E+02
12.8999996E-02 23.8626118E+04  0.            63.4056455E+03-48.5601011E-01-62.4837480E+03 33.8984384E+00 12.0940879E+02

   MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 54.1337201E+00-54.6322310E+02  0.           -16.2595926E+03-51.7807530E+02  0.            10.0110762E-02
42.9115000E-04 25.8138133E-03 27.2118782E+01  0.           -63.4139524E+03 27.2731050E+01  0.            12.8999996E-02
42.9115000E-04 25.8138133E-03 27.2118782E+01  0.           -63.4139524E+03 27.2731050E+01  0.            12.8999996E-02

   SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-87.4127159E-01 61.2305463E-01 92.2998990E-02  0.            0.             0.           -21.5753137E+02-24.7441046E+01
-31.2907655E-01-16.9089398E-02 14.6599933E-01  0.            0.             0.            34.9655192E+00-28.8126009E+01
-31.2907655E-01-16.9089398E-02 14.6599933E-01  0.            0.             0.            34.9655192E+00-28.8126009E+01

   FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

-31.3661573E+02  0.           -14.3137661E+04  0.            18.6781461E+04  0.           -31.3661573E+02  0.

   FZM            LM             MM             NM
```

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ORIGINAL PAGE IS
OF POOR QUALITY

```
-14.3074474E+04  0.            10.9752814E+04  0.
       VPCS
 38.7489900E+02
       TFFS
  0.              0.
                                                                T(I)
                  0.                0.
       SAC1
 32.4703842E-03 29.5525780E-03-12.4313683E-02  0.            0.              74.7971731E-04  0.
       FLEX
     POINT           XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T            YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F
 10.0000000E-01  0.             -34.2507323E-01  0.             0.             27.3302231E-01-35.3269603E+00  0.
 28.9824163E+01  0.               0.            -15.1122214E-02 11.5153010E+00  0.              0.            -18.3181017E-03
 20.0000000E-01  0.             -29.4069340E-01  0.             0.             61.6251319E-01-30.8468917E+00  0.
 28.9470275E+01  0.               0.            -51.8639650E-05 10.2695324E+00  0.              0.            -13.1007953E-03
 30.0000000E-01  0.             -18.6614672E-01  0.             0.            -56.4438719E-01-37.0275326E+00  0.
 28.9724314E+01  0.               0.             21.9581767E-03 33.0923355E-01  0.              0.             14.3576024E-03
 40.0000000E-01  0.             -90.0224965E-02  0.             0.             69.0878087E-01-20.1182484E+00  0.
 28.9824945E+01  0.               0.            -10.3698942E-02-22.4742796E-01  0.              0.            -22.5633879E-03
                                                          LANDING ROLL
                              ISS =  1          ILR = 1           ICS = 0          IBS = 1
      AUTS
      TI             TR
 17.1000000E-02 19.4125000E-01
                                                          PITCH AUTOPILOT
      DELQN          ALPHAE         ALPHO1         ALPDO1         ALPHET         DELQDE
 30.2904551E-01 21.0562305E-02-10.4671402E+00  0.            21.0562305E-02 80.0000000E-01

                STAGE ON--INCR. DELTA1
```

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                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                          GENERALIZED COMPUTER PROGRAM

          INDSDF  2      CASE LROLL        STAGE  1      PAGE    175

      PRINT       .05
      AMAXER      .01
      DELTS       .01
      INDSTF      1
              TRA

   2SDF

21.1225000E-01 21.1225000E-01 61.6865721E+01  0.             69.7428317E-01 28.9820790E+01  0.             38.0997490E-01
 0.           -18.4135362E-02  0.           25.9624672E-02 28.9845832E+01 99.8228702E+00 28.9845762E+01  0.
20.0298634E-02 75.3165115E-02  0.          -10.4671402E+00  0.            -39.5934277E-03  0.             71.3570731E-02
 0.             0.           -20.3138247E-01  0.            -31.7634531E+00 12.4671000E+04  0.              0.
 0.             0.

   LGEAR

   DELTA          P              P2             FT             SR             SF             AA             FC2

10.0110762E-02 95.6647080E+03  0.            16.3263697E+03 13.2461524E-01-16.2171679E+03 22.1056180E+00-51.2816563E+02
12.8999996E-02 23.8626118E+04  0.            63.4056455E+03-48.5601011E-01-62.4837480E+03 33.8984384E+00 12.0940879E+02
12.8999996E-02 23.8626118E+04  0.            63.4056455E+03-48.5601011E-01-62.4837480E+03 33.8984384E+00 12.0940879E+02

   MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 54.1337201E+00-54.6322310E+02  0.           -16.2595926E+03-51.7807530E+02  0.             10.0110762E-02
42.9115000E-04 25.8138133E-03 27.2118782E+01  0.           -63.4139524E+03 27.2731050E+01  0.             12.8999996E-02
42.9115000E-04 25.8138133E-03 27.2118782E+01  0.           -63.4139524E+03 27.2731050E+01  0.             12.8999996E-02

   SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-87.4127159E-01 61.2305463E-01 92.2998990E-02  0.             0.             0.           -21.5753137E+02-24.7441046E+01
-31.2907655E-01-16.9089398E-02 14.6599933E-01  0.             0.             0.            34.9655192E+00-28.8126009E+01
-31.2907655E-01-16.9089398E-02 14.6599933E-01  0.             0.             0.            34.9655192E+00-28.8126009E+01

   FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

-31.3661573E+02  0.           -14.3137661E+04  0.            18.6781461E+04  0.           -31.3661573E+02  0.

   FZM            LM             MM             NM

-14.3074474E+04  0.            18.9752814E+04  0.

   VPCS

38.7489900E+02

   TFFS

 0.             0.
```

```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM
                    INDSOF  2     CASE LROLL       STAGE  1     PAGE    176

                                                       T(I)
             0.                  0.
     SAC1

32.4703842E-03 29.5525780E-03-12.4313683E-02  0.            0.          74.7971731E-04  0.
     FLEX

     POINT          XD2F          XD2T          YD2F          YD2T          ZD2F          ZD2T          XD1F
     XD1T           YD1F          YD1T          ZD1F          ZD1T          XD0F          YD0F          ZD0F

10.0000000E-01  0.          -34.2507323E-01  0.            0.          27.3302231E-01-35.3269603E+00  0.
28.9824163E+01  0.            0.          -15.1122214E-02 11.5153010E+00  0.            0.          -18.3181017E-03
20.0000000E-01  0.          -29.4069340E-01  0.            0.          61.6251319E-01-30.8468917E+00  0.
28.9470275E+01  0.            0.          -51.0639650E-05 10.2695324E+00  0.            0.          -13.1007953E-03
30.0000000E-01  0.          -18.6614672E-01  0.            0.          -56.4438719E-01-37.0275326E+00  0.
28.9724314E+01  0.            0.           21.9581767E-03 33.0923355E-01  0.            0.           14.3576024E-03
40.0000000E-01  0.          -90.0224965E-02  0.            0.          69.0878087E-01-20.1182484E+00  0.
28.9824945E+01  0.            0.          -10.3698942E-02-22.4742796E-01  0.            0.          -22.5633879E-03
                                                    LANDING ROLL
                              ISS =  1         ILR = 1          ICS = 0         IBS = 1
    AUTS

    TI             TR

17.1000000E-02 19.4125000E-01

                                                   PITCH AUTOPILOT

     DELQN          ALPHAE        ALPHD1        ALPD01        ALPHET        DELQDE

30.2904551E-01 21.0562305E-02-10.4671402E+00  0.          21.0562305E-02 80.0000000E-01

INTEG RTN.      HT =   4.00000000E-03
INTEG RTN.      HT =   2.00000000E-03
INTEG RTN.      HT =   2.00000000E-03
INTEG RTN.      HT =   4.00000000E-03
INTEG RTN.      HT =   2.00000000E-03

     2SDF

21.6225000E-01 21.6225000E-01 63.1355141E+01  0.          69.6309417E-01 28.9742110E+01  0.           12.7161591E-01
 0.           -17.1755978E-02  0.           25.9534255E-02 28.9744901E+01 99.7533936E+00 28.9744788E+01  0.
25.5905159E-02 25.1457261E-02  0.          -95.8483190E-01  0.          -50.6038955E-03  0.            20.0853135E-02
 0.             0.          -14.4452442E-01  0.          -30.8862039E+00 12.4671000E+04  0.             0.
 0.             0.

     LGEAR
```

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                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                         GENERALIZED COMPUTER PROGRAM

              INDSOF  2     CASE LROLL        STAGE  1      PAGE      177

   DELTA              P              P2              FT              SR              SF              AA              FC2

14.6814006E-02 20.3337994E+04  0.             25.6863556E+03-11.8427474E+00-25.7483637E+03-12.1473877E+00-31.4896887E+02
12.2365438E-02 22.9620854E+04  0.             58.8556558E+03 10.7801140E-01-58.0360320E+03 30.1378031E+00 33.0985029E+02
12.2365438E-02 22.9620854E+04  0.             58.8556558E+03 10.7801140E-01-58.0360320E+03 30.1378031E+00 33.0985029E+02

   HUVP              VGPT            FTRX            FTRY            FTRZ            HA              HB              DDELTA

60.9390613E-03 36.6507299E-02-15.6509955E+02  0.              -25.6830269E+03-14.1156750E+02  0.              14.6014006E-02
42.7635998E-04 25.7225288E-03 25.1693291E+01  0.              -58.8568998E+03 25.3929475E+01  0.              12.2365438E-02
42.7635998E-04 25.7225288E-03 25.1693291E+01  0.              -58.8568998E+03 25.3929475E+01  0.              12.2365438E-02

   SD2               SD1             S               S2D2            S2D1            S2              OMETD1          OMET

-56.1639374E+00 47.9812150E-01 12.0855563E-01  0.              0.              0.              -58.8153125E+01-31.9680913E+01
-95.7987792E-02-27.9726745E-02 14.5430963E-01  0.              0.              0.               32.5550610E+00-28.6205421E+01
-95.7967792E-02-27.9726745E-02 14.5430963E-01  0.              0.              0.               32.5550610E+00-28.6205421E+01

   FTRA              FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

-55.9022944E+01  0.             -14.3399667E+04  0.             56.2508115E+04  0.             -55.9022944E+01  0.

   FZM               LM              MM              NM

-14.3661408E+04  0.              57.2392094E+04  0.

   VPCS

38.7489900E+02

   TFFS

 0.              0.

                                                                 Y(I)
                  0.              0.

   SAC1

32.4793797E-03 31.4672880E-03-14.9780582E-02  0.              0.              80.1784893E-04  0.

   FLEX

   POINT             XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
   XD1T              YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.             -27.1999248E-01  0.              0.              42.2145578E-01-43.2499766E+00  0.
28.9745862E+01  0.              0.              24.1751114E-03 86.2405180E-01  0.              0.             -21.8437785E-03
20.0000000E-01  0.             -18.0211719E-01  0.              0.              56.4091431E-02-44.0160941E+00  0.
28.9414152E+01  0.              0.              18.8819091E-02 74.8620150E-01  0.              0.             -72.2893881E-04
30.0000000E-01  0.             -11.0123624E-01  0.              0.             -12.9864936E-01-31.0964496E+00  0.
```

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                                      SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM

                              INDSDF  2     CASE LROLL        STAGE  1     PAGE    178

28.9652899E+01  0.              0.             -16.7814201E-02 61.6243171E-02  0.              0.             98.2168362E-04
40.0000000E-01  0.             -55.5159561E-02  0.              0.             29.6758905E-01-15.3501442E+00  0.
28.9745585E+01  0.              0.             16.4788776E-02-41.1763287E-01  0.              0.             -20.2315289E-03

                                                       LANDING ROLL
                                 ISS =  1          I.R = 1          ICS = 0          IBS = 1
    AUTS

    TI              TR

17.1000000E-02 19.9125000E-01

                                                     PITCH AUTOPILOT

    DELQH           ALPHAE          ALPHO1          ALPDD1          ALPHET          DELQDE

30.2904551E-01 21.0562305E-02-95.8483190E-01  0.              21.0562305E-02 80.0000000E-01

INTEG RTN.      HT =  4.00000000E-03
INTEG RTN.      HT =  4.00000000E-03
                                    TIRE DEFLECTION EXCEEDED          DELTA(1) =   2.0053015E-01
INTEG RTN.      HT =  4.00000000E-03

      2SDF

21.8625000E-01 21.8625000E-01 63.8308523E+01  0.             69.5670893E-01 28.9701378E+01  0.             12.8493429E-02
 0.           -15.9598999E-02  0.             25.9495290E-02 28.9701406E+01 99.7234660E+00 28.9701285E+01  0.
26.8558618E-02 25.4128260E-03  0.            -92.8086251E-01  0.            -53.1131020E-03  0.            -27.7014395E-03
 0.             0.           -21.1186955E-01  0.            -32.6798737E+00 12.4671000E+04  0.             0.
 0.             0.

    LGEAR

    DELTA           P               P2              FT              SR              SF              AA              FC2

20.0530148E-02 32.1110133E+04  0.              37.0625599E+03-25.2453298E+00-37.0989053E+03-73.5738284E-01-13.2045782E+02
12.0249744E-02 22.4845351E+04  0.              57.4247866E+03 24.5240969E-01-56.6156044E+03 29.7538634E+00 34.8732586E+02
12.0249744E-02 22.4845351E+04  0.              57.4247866E+03 24.5240969E-01-56.6156044E+03 29.7538634E+00 34.8732586E+02

    MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

86.7051117E-03 52.1541791E-02-32.1360363E+02  0.             -37.0636006E+03-27.2316450E+02  0.             20.0530148E-02
24.0771911E-04 14.4839644E-03 13.8262656E+01  0.             -57.4247449E+03 13.9783580E+01  0.             12.0249744E-02
24.0771911E-04 14.4839644E-03 13.8262656E+01  0.             -57.4247449E+03 13.9783580E+01  0.             12.0249744E-02

    SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

-64.7767109E+00 31.0705813E-01 13.0479289E-01  0.              0.              0.             -11.3465187E+02-34.0099382E+01
32.2747838E-03-28.7128354E-02 14.4744319E-01  0.              0.              0.             17.9209719E+00-28.5605215E+01
32.2747838E-03-28.7128354E-02 14.4744319E-01  0.              0.              0.             17.9209719E+00-28.5605215E+01

    FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM
```

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                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM
                     INDSOF  2      CASE LROLL        STAGE  1     PAGE     179

-31.1052515E+02  0.           -15.1911654E+04  0.           95.3566575E+04  0.          -30.1052515E+02  0.
     FZH            LM               MM            NH
-15.2281879E+04  0.            96.4205719E+04  0.
     VPCS
38.7489900E+02
     TFFS
 0.              0.

                                                              T(I)
                   0.                  0.
     SAC1
32.4872233E-03 32.3831056E-03-16.1046668E-02  0.            0.             62.2923339E-04  0.
     FLEX
    POINT          XD2F           XD2T            YD2F           YD2T           ZD2F           ZD2T           XD1F
    XD1T           YD1F           YD1T            ZD1F           ZD1T           XD0F           YD0F           ZD0F
10.0000000E-01  0.            -32.5240597E-01  0.              0.             41.1800958E-01-55.6486512E+00  0.
28.9704573E+01  0.              0.            12.8530724E-02 70.6658675E-01  0.              0.          -20.0210801E-03
20.0000000E-01  0.            -18.4303439E-01  0.              0.            -27.6453393E-01-57.7657241E+00  0.
28.9395933E+01  0.              0.            16.4512752E-02 58.9226573E-01  0.              0.          -28.4621124E-04
30.0000000E-01  0.            -16.5886682E-01  0.              0.             15.4501461E-01-29.3457206E+00  0.
28.9619143E+01  0.              0.           -16.7881872E-02-49.2437333E-02  0.              0.           56.7421359E-04
40.0000000E-01  0.            -13.6399346E-01  0.              0.             17.1453016E-02-11.9817521E+00  0.
28.9703879E+01  0.              0.            20.6029964E-02-48.2583891E-01  0.              0.          -15.6702759E-03
                                                          LANDING ROLL
                        ISS =  1          ILR = 1            ICS = 0          IBS = 1
    AUTS
     TI             TR
17.1800000E-02 20.1525000E-01
                                                        PITCH AUTOPILOT
    DELON          ALPHAE         ALPHD1          ALPDD1          ALPHET         DELQDE
38.2904551E-01 21.0562305E-02-92.8086251E-01  0.              21.0562305E-02 80.0000000E-01
```

STOP

APPENDIX H

AIRPLANE B FLEXIBLE BODY EXAMPLE 5

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STCASE TAB
ATAB01       2
ATAB02       2
ATAB80       2
ATAB10       2
ATAB11       2
ATAB12       2
ATAB15       2
ATAB16       2
ATAB51       2
ATAB52       2
ATAB53       2
ATAB56       2
ATAB57       2
CTAB01       13
CTAB02       13
FTAB02       5
FTAB03       20
TTAB10       50
VTAB01       5
VTAB02       5
VTAB03       5
VTAB04       5
VTAB06       5
        TRA
REM     BCD  3SDF2-PLANPLANE
NCASE   BCD  1LROLL
REM     BCD  4INTEGRATION INFORMATION
IVARBH       0
TMAX         40.
AMINER       .00005
PRTMIN       .0
AMAXER       .001
DELTS        .001
PRINT        .05
REM     BCD  3REQD FOR SDF-2
AMASS        3874.899
HGC7F        10.0
GAM7D        -1.16060
VG77F        296.22076
THTBD        10.3394
RHHGR        .0
INDAPC       1
INDADD       1
INDFPA       1
INDPLA       1
INDACM       2
INDGRT       1
INDWGT       1
REM     BCD  5VEHICLE PHYSICAL PROP. DATA
INDVPC       1
XCGRF        .0
VTAB01       2,0.,0.,5000.,1.
VTAB02       2,0.,1.59702E+6,5000.,1.59702E+6
VTAB03       2,0.,1.59702E+6,5000.,1.59702E+6
VTAB04       2,0.,1.59702E+6,5000.,1.59702E+6
INDXZS       1
VTAB06       2,0.,1.0E+5,5000.,1.0E+5
REM     BCD  4AERODYNAMIC INPUT DATA
INDAER       1
AREFF        1605.
D1RFF        37.7
D2RFF        56.7
INDA01       1
ATAB01       -7.9573427E-3,-5.5941985E-3
```

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ATAB02       1.4020979E-3,8.8931664E-4
I DA02       1
INDA80       1
ATAB80       4.18951E-2,2.00844E-2
INDA10       1
ATAB10       -3.978321E-2,-3.9650349E-2
INDA11       1
ATAB11       5.7452448E-2,3.7645688E-2
INDA12       1
ATAB12       1.4720279E-3,1.2354312E-3
INDA15       1
ATAB15       -1.725E-2,-1.45E-2
INDA16       1
ATAB16       1.25E-4,5.0E-5
INDA51       1
ATAB51       7.3516484E-3,1.7027972E-3
INDA52       1
ATAB52       -5.2147852E-4,1.0238928E-3
INDA53       1
ATAB53       -3.1368631E-4,1.8065268E-5
INDA56       1
ATAB56       8.7E-3,7.3418182E-3
INDA57       1
ATAB57       2.0E-5,3.6363636E-5
REM     BCD  3ENGINE.THRUST DATA
INDTFF       3
INDTSO       1
IT10X        4
TTAB10       -2.,-1.5,-1.,-.5,0.,.5,1.,1.5,2.
TTAB10       0.,.1,.2,.3                                              10
TTAB10       0.,0.,0.,0.,0.                                           14
TTAB10       0.,0.,0.,0.                                              19
TTAB10       0.,0.,0.,0.,0.                                           23
TTAB10       0.,0.,0.,0.                                              28
TTAB10       0.,0.,0.,0.,0.                                           32
TTAB10       0.,0.,0.,0.                                              37
TTAB10       0.,0.,0.,0.,0.                                           41
TTAB10       0.,0.,0.,0.                                              46
IT10W        9
REM     BCD  3LANDING GEAR DATA
NSTRUT       3
MASS         4.940000,27.19587,27.19587
RX           35.0833,-2.83867,-2.83867
RY           0.,-8.3333,+8.3333
RZ           1.91667,.509583,.509583
THETAD       0.,0.,0.
ERDEG        0.
RGR          4.47
NTIRES       2.,3.,3.
RZERO        1.0479167,1.13125,1.13125
W            .554167,.604167,.604167
DELTAM       .198333,.1958333,.19583333
RLT          1.5E+3
IFD          1
AI           1.3204533E+5,3.8129286E+5,3.8129286E+5
BI           1.2112257,1.412391,1.412391
FTAB02       2,0.,0.,1.5E+4,0.
FTAB03       6,0.,0.,.007,.336,.1,.336,.4,.336,1.,.336,100.,.336
MOMENT       1.2,2.6,2.6
MB           0.,0.,0.
RF           5.48333,6.8792,6.8792
VZ           0.
PZERO        35280.,40320.,40320.
VZERO        0.1614583,.4716435,.4716435
A            .1104166,.2673611,.2673611
```

```
I'        1
I  JC01   1
NSMAIN    2
CTABC1    0.,1.6667,1.,2.,3.
CTABC1    136.781,136.781,443.92,443.92,443.92,443.92,443.92          6
CTABC1    443.92                                                     13
INDCC2    1
CTABC2    0.,1.6667,1.,2.,3.
CTABC2    136.781,136.781,4.23E+4,4.23E+4,4.23E+4,4.23E+4             6
CTABC2    4.23E+4,4.23E+4                                            12
MUS       .1,.1,.1
ES        .0001333,.00016667,.00016667
SB        1.333,1.6667,1.6667
REM   BCD 4FLEXIBLE AIRFRAME DATA
INDFLX    1
NMODE     8
GMASS1    66.6617,79.4557,73.8341,18.1131
GMASS1    29.0656,99.7316,70.4027,31.6212                        5
GFREQ     13.138,16.512,33.359,43.398
GFREQ     48.198,61.123,74.123,87.198                            5
SZMOD     .08,-.10,-.10,-.02,-.0942,-.0942
SZMOD     -.153,.1393,.1393,-.065,.0112,.0112                    7
SZMOD     .04,-.0087,-.0087,.185,.12,.12                        13
SZMOD     -.01,.105,.105,.05,-.01,-.01                          19
ARMODE    0.,0.,-.1140,0.,-4.239E-4,0.
ARMODE    0.,0.,-.0414,0.,3.6430E-4,0.                           7
ARMODE    0.,0.,.04350,0.,-6.030E-4,0.                          13
ARMODE    0.,0.,.06440,0.,-2.034E-5,0.                          19
ARMODE    0.,0.,-.0342,0.,-5.653E-5,0.                          25
ARMODE    0.,0.,-.0054,0.,-1.351E-1,0.                          31
ARMODE    0.,0.,-.1258,0.,3.716E-4,0.                           37
ARMODE    0.,0.,-.0323,0.,-9.602E-4,0.                          43
NPTS      4
OUTMOD    0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.
OUTMOD    .197,-.0385,.0035,.0035,.0254,.3028,-.1673,-.1157     17
OUTMOD    0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.       25
OUTMOD    .08,-.02,-.153,-.065,.04,.185,-.01,.05                41
OUTMOD    0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.       49
OUTMOD    -.1,-.0042,.1393,.0112,-.0087,.12,.105,-.01           65
OUTMOD    0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.       73
OUTMOD    .203,-.244,-.1072,-.125,.1998,-.4409,-.0165,-.2167    89
ROIS      42.6667,0.,0.,35.0833,0.,1.91667
ROIS      -2.83867,8.3333,.509583,-32.3333,0.,0.                 7
REM   BCD 3PLOT TAPE DATA
IPLT      1
ISDF      1
ISTPL2    1
IFLX  INT 1,0,1,1
REM   BCD 3AUTOPILOT DATA
REM   BCD 3A. ENGINE DATA
INDAUT    1
IN        2
ZN        -.55,-.55
YN        -14.1667,14.1667
N         0.,0.
REM   BCD 3B. DRAG CHUTE DATA
ICS       0
CDCH      .244
SSH       1605.
XCH       -9.625
YCH       0.
ZCH       -2.41667
REM   BCD 5C. PHASE BEGIN-TERMINATE
ITO       0
HF        12.25
  :
```

```
NF              0
Y  F            0.
HRF             8.796
DELTAH          3.
NLRI            0
TI              0.
KP              0
VS              10.
XS              3000.
TS              12.
HS              0.
REM       BCD 4G. HOLD MANEUVER DATA
ALPDES          11.5
TTD             0.
KE        INT 1,1
PM              11.5
REM       BCD 5H. LANDING ROLL MANEUVER DATA
TSP             0.
TRV             0.
TCH             7.
TBK             0.
ISS             0.
ILR             0
IBS             0
REM       BCD 5I. ENGINE FAILURE STAGE DATA
IC        INT 0,0
XRF1            0.
IT1       INT 0,0
XRF2            0.
IT2       INT 0,0
H1              0.
IH1       INT 0,0
H2              0.
IH2       INT 0,0
HR1             0.
IHR1      INT 0,0
HR2             0.
IHR2      INT 0,0
TR1             0.
ITR1      INT 0,0
TR2             0.
ITR2      INT 0
REM       BCD 5J. BRAKE COND.STAGE DATA
IB        INT 0,0,0
TBK1            1.
IBK1      INT 0,0,0
TBK2            1.
IBK2      INT 0,0,0
REM       BCD 4K. PITCH AUTOPILOT DATA
TST             .2
ALPDL           2.
RFALPH          0.
DELALA          .01
PSH             0.
PSH2            0.
RFALP2          0.
DELQF           8.
DELQTO          0.
DELQL           -10.
DELQU           +25.
DELFD1          5.25
REM       BCD 4L. YAW AUTOPILOT DATA
RFB             .5
DELBA           .05
PSR             10.
```

```
DPSIA        .05
F  PSI       .5
PSPSI        0.
DELRL        -20.
DELRU        +20.
REM     BCD  4M. ROLL AUTOPILOT DATA
RFPHI        .5
DPHIA        .05
PSA          -10.
DELPL        -12.
DELPU        +12.
REM     BCD  5N.THROTTLE AUTOPILOT DATA
TF      INT  0,0
NDF          0.,0.
IR      INT  0,0
NB           1.,1.
NLR          0.,0.
NTO          0.,0.
K2           1.
REM     BCD  40. BRAKE AUTOPILOT DATA
MBC          0.,0.,0.
PO           .1
DELTAH       .001
OMECD1       20.
MBL          0.,0.,0.
MBU          0.,0.,0.
REM     BCD  5P. CONTROL RESPONSE DATA
DELHS        5.25
DELRRD       31.5
DELA         10.
NED1         .1
REM     BCD  40. INITIALIZATION
IAP          3
HR           10.
DELQD        4.56478
DELQDE       4.56478
DELQN        4.56478
DELPD        0.
DELRD        0.
MANLOG       1
PITCHP       1
REM     BCD  2STAGING DATA
REM     BCD  4A.GEARS INTO PROGRAM
INDLG        0
ISTAGE       0
DECRES  BCD  1HR
STESTD       11.0
        TRA
INDLG        -1
REM     BCD  4B.SMOOTH IMPACT STAGE
AINCRS  BCD  3DDELT1DDELT2DDELT3
STEST        -.05,-.05,-.05
        TRA
PRINT        .02
DELTS        .005
AMAXER       .0005
PRTMIN       0.
AINCRS  BCD  1TIMES
STEST        .9
        TRA
ATAB51       7.3516484E-3,1.7027972E-3
ATAB52       -5.2147852E-4,1.0238928E-3
ATAB53       -3.1368631E-4,1.8065268E-5
ATAB56       0.,0.
ATAB57       0.,0.
```

```
REM    BCD 5C. EFFICIENT AMAXER STAGE
AINCRS BCD 4DELTA1DELTA2DELTA3
STEST      .1,.1,.1
       TRA
PRINT      .05
AMAXER     .01
DELTS      .01
REM    BCD 4D.SMOOTH IMPACT STAGE
AINCRS BCD 1DDELT1
STEST      -.05
       TRA
PRINT      .02
DELTS      .005
AMAXER     .0005
REM    BCD 5E. EFFICIENT AMAXER STAGE
AINCRS BCD 1DELTA1
STEST      .1
       TRA
PRINT      .05
AMAXER     .01
DELTS      .01
INDSTF     1
       TRA
```

```
                SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                      GENERALIZED COMPUTER PROGRAM

        INDSDF  2      CASE LROLL         STAGE  1      PAGE       8

     A.GEARS INTO PROGRAM


     INITIAL PRINT OUT FOR VPCS
 XCGRF        AREFF        D1RFF        D2RFF
0.           16.0500000E+02 37.7000000E+00 56.7000000E+00

     PRINT CODES IDENTIFYING TIME HISTORY
  2SDF
 TIME         TIMES        XG77F        YG77F        HGC7F        U777F        V777F        W777F
 PI77R        QI77R        RI77R        AMACH        VA77F        DYNPP        XG77F1       YG77F1
 ZG77F1       ALPHD        BETAD        ALPHD1       BETAD1       GAM7D        SIG7D        THTPD
 PSIPD        PHIPD        AX77F        AY77F        AZ77F        WTR7P        FDC          FCX
 FCY          FCZ
  VPCS
 AMASS
  TFFS
 MT           NT
  SAC1
 CAVAM        CA           CN           CY           CL           CM           CNN
```

```
                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                        GENERALIZED COMPUTER PROGRAM

                        INDSOF  2      CASE LROLL        STAGE  1      PAGE       9

       2SDF

  0.             0.             0.             0.             10.0000000E+00 29.0274042E+01  0.                           59.0569126E+00
  0.             0.             0.             26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00   0.             0.              0.            -11.6059853E-01  0.             10.3393988E+00
  0.             0.           57.7454851E-01   0.            -31.6515539E+00 12.4671000E+04  0.              0.
  0.             0.

       VPCS

38.7489900E+02

       TFFS

 0.             0.

                                                         T(I)
               0.                  0.

       SAC1

29.7745819E-03-20.8749533E-03 60.9750559E-02  0.             0.             15.3281670E-03  0.

                                                         FLARE
      AUTS

      ALPDES         PHIDES         TTD

11.5000000E+00  0.             0.

                                                     PITCH AUTOPILOT

      DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE

26.8544760E-01-14.0024531E-07  0.             0.            -14.0024531E-07 26.8544760E-01

INTEG RTN.     HT =  1.0000000E-03

       2SDF

  0.             0.             0.             0.             10.0000000E+00 29.0274042E+01  0.                           59.0569126E+00
  0.             0.             0.             26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00   0.             0.              0.            -11.6059853E-01  0.             10.3393988E+00
  0.             0.           90.1422983E-02   0.            -26.3302709E+00 12.4671000E+04  0.              0.
  0.             0.

       VPCS

38.7489900E+02
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSUF 2 CASE LROLL STAGE 1 PAGE 10

TFFS

0. 0.

T(I)

0. 0.

SAC1

29.7745819E-03-20.8749533E-03 66.9750569E-02 0. 0. 15.3281670E-03 0.

FLARE

AUTS

ALPDES PHIDES TTD

11.50000000E+00 0. 0.

PITCH AUTOPILOT

DELQN ALPHAE ALPHD1 ALPDD1 ALPHET DELQDE

27.56072038E-01-14.0024531E-07 0. 0. -14.0024531E-07 27.56072038E-01

STAGE ON--DECR. HR

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SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
          INOSDF  2      CASE LROLL        STAGE  1      PAGE      11

      INDLG        -1
      REM     BCD 40.SMOOTH IMPACT STAGE
      AINCRS  BCD 3DDELT1DDELT2DDELT3
      STEST        -.05,-.05,-.05
                TRA

   2SDF

0.              0.              0.              0.             10.0000000E+00 29.0274042E+01  0.             59.0569126E+00
0.              0.              0.          26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01   0.
59.9992281E-01 11.4999986E+00   0.              0.              0.         -11.6059853E-01  0.             10.3393988E+00
0.              0.          90.1422903E-02  0.           -26.3302709E+04 12.4671000E+04  0.              0.
0.              0.

   LGEAR

   DELTA           P               P2              FT              SR              SF              AA              FC2

0.             35.2800000E+03  0.              0.             31.9713310E-01-38.9549765E+02-78.8562277E+01  0.
0.             40.3200000E+03  0.              0.             54.9315280E-01-10.7799996E+03-39.6363699E+01  0.
0.             40.3200000E+03  0.              0.             54.9315280E-01-10.7799996E+03-39.6383699E+01  0.

   MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

33.6000000E-02 29.6159990E+01  0.              0.             -0.              0.              0.             -79.6095154E-01
33.6000000E-02 29.6159990E+01  0.              0.             -0.              0.              0.             -10.9046626E-01
33.6000000E-02 29.6159990E+01  0.              0.             -0.              0.              0.             -10.9046626E-01

   SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

0.              0.              0.              0.              0.              0.              0.              0.
0.              0.              0.              0.              0.              0.              0.              0.
0.              0.              0.              0.              0.              0.              0.              0.

   FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

0.              0.              0.              0.              0.              0.              0.              0.

   FZM             LM              MM              NM

0.              0.              0.              0.

     VPCS

38.7489900E+02

     TFFS

0.              0.
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 12

T(I)

0. 0.

SAC1

29.7745819E-03 -20.8749533E-03 60.9750569E-02 0. 0. 15.3281670E-03 0.

FLEX

POINT / XD1T	XD2F / YD1F	XD2T / YD1T	YD2F / ZD1F	YD2T / ZD1T	ZD2F / XD0F	ZD2T / YD0F	XD1F / ZD0F
10.0000000E-01	0.	90.1295544E-02	0.	0.	0.	-28.9135646E+00	0.
29.0274042E+01	0.	0.	0.	59.0569126E+00	0.	0.	-21.0484329E-04
20.0000000E-01	0.	10.1739412E-01	0.	0.	0.	-28.4544208E+00	0.
29.0274042E+01	0.	0.	0.	59.0569126E+00	0.	0.	-12.4482040E-04
30.0000000E-01	0.	93.2374457E-02	0.	0.	0.	-26.1584011E+00	0.
29.0274042E+01	0.	0.	0.	59.0569126E+00	0.	0.	16.2379000E-04
40.0000000E-01	0.	90.1254801E-02	0.	0.	0.	-24.3726223E+00	0.
29.0274042E+01	0.	0.	0.	59.0569126E+00	0.	0.	-27.7776622E-04

FLARE

AUTS

ALPDES	PHIDES	TTD
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
27.5339224E-01	-14.0024531E-07	0.	0.	-14.0024531E-07	27.5339224E-01

```
INTEG RTN.    HT =  8.0000000E-04
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
INTEG RTN.    HT =  1.6000000E-03
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INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
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INTEG RTN.        HT =   1.60000000E-03
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INTEG RTN.        HT =   1.60000000E-03
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INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
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INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03
INTEG RTN.        HT =   1.60000000E-03

    2SDF

50.0000000E-03 50.0000000E-03 14.8031852E+00  0.                    96.9255678E-01 29.0027316E+01  0.                 59.3319876E+00
 0.            27.2363745E-04  0.            26.5170101E-02 29.6333999E+01 10.4122497E+01 29.5967086E+01  0.
62.9389516E-01 11.5616894E+00  0.            12.6451639E-01  0.            -12.1824054E-01  0.                 10.3434483E+00
 0.             0.            94.7823961E-02  0.            -26.7932175E+00 12.4671000E+04  0.                  0.
 0.             0.

    LGEAR

    DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.            31.5307209E-01-38.9549765E+02-78.8562277E+01  0.
 0.            40.3200000E+03  0.             0.            50.0347775E-01-10.7799996E+03-39.6383699E+01  0.
 0.            40.3200000E+03  0.             0.            50.0347775E-01-10.7799996E+03-39.6383699E+01  0.

    MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA
```

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```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM
                         INOSDF  2     CASE LROLL        STAGE  1     PAGE     14

 33.6000000E-02 29.5969717E+01  0.         0.          -0.         0.          0.         -76.6526922E-01
 33.6000000E-02 29.5988332E+01  0.         0.          -0.         0.          0.         -78.1315998E-02
 33.6000000E-02 29.5988332E+01  0.         0.          -0.         0.          0.         -78.1315998E-02
      SO2            SD1            S           S2D2         S2D1         S2          OMETD1        OMET
   0.             0.           0.          0.           0.          0.          0.          0.
   0.             0.           0.          0.           0.          0.          0.          0.
   0.             0.           0.          0.           0.          0.          0.          0.
      FTRA           FTRB          FTRC          HTX          HTY          HTZ          FXM          FYM
   0.             0.           0.          0.           0.          0.          0.          0.
      FZM            LM            MM           NM
-40.9444643E-02  0.        -27.3064447E-01  0.
       VPCS
 38.7489980E+02
       TFFS
   0.             0.

                                                      T(I)
               0.                 0.
       SAC1
 30.0142492E-03-21.9770026E-03 62.1246433E-02  0.          0.          12.2577445E-03  0.
       FLEX
      POINT          XD2F          XD2T          YD2F          YD2T          ZD2F          ZD2T          XD1F
      XD1T           YD1F          YD1T          ZD1F          ZD1T          XD0F          YD0F          ZD0F

 10.0000000E-01  0.          94.7424930E-02  0.            0.          -60.3750620E-04-28.8624243E+00  0.
 29.0027310E+01  0.           0.          -12.0030225E-05 59.2156589E+00  0.            0.          -21.0662029E-04
 20.0000000E-01  0.          10.4018379E-01  0.            0.          -83.8182193E-04-28.4980838E+00  0.
 29.0032533E+01  0.           0.          -19.9376245E-05 59.2362340E+00  0.            0.          -12.4000461E-04
 30.0000000E-01  0.          97.2566696E-02  0.            0.           83.2327787E-04-26.6476327E+00  0.
 29.0028700E+01  0.           0.           31.6901258E-05 59.3400360E+00  0.            0.           16.2990389E-04
 40.0000000E-01  0.          94.7926221E-02  0.            0.          -13.3526523E-03-25.2430775E+00  0.
 29.0027309E+01  0.           0.          -51.3689637E-05 59.4195381E+00  0.            0.          -27.8760104E-04
                                                      FLARE
      AUTS
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 15

ALPDES	PHIDES	TTO
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
28.3042090E-01	61.6894058E-03	12.6451639E-01	0.	61.6094058E-03	28.3042090E-01

```
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
INTEG RTN.      HT =   1.6000000E-03
```


ORIGINAL PAGE IS
OF POOR QUALITY

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM


```
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03
INTEG RTN.      HT =  1.6000000E-03

        2SDF

 10.0000000E-02 10.0000000E-02 29.5966729E+00  0.             93.7100967E-01 28.9775565E+01  0.             59.6180275E+00
  0.            48.1970706E-04  0.            26.5000397E-02 29.5844871E+01 10.3990475E+01 29.5772045E+01  0.
 65.6392920E-01 11.6257341E+00  0.            12.9187072E-01  0.            -12.7132816E-01  0.            10.3544047E+00
  0.             0.            99.5792447E-02  0.           -27.2804053E+00 12.4671000E+04  0.              0.
  0.             0.

       LGEAR

       DELTA          P              P2             FT             SR             SF             AA             FG2

  0.            35.2800000E+03  0.             0.            31.1198337E-01-38.9549765E+02-78.8562277E+01  0.
  0.            40.3200000E+03  0.             0.            44.7848961E-01-10.7799996E+03-39.6383699E+01  0.
  0.            40.3200000E+03  0.             0.            44.7848961E-01-10.7799996E+03-39.6383699E+01  0.

       HJVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 33.6000000E-02 29.5776613E+01  0.             0.            -0.             0.             0.            -73.5659757E-01
 33.6000000E-02 29.5809669E+01  0.             0.            -0.             0.             0.            -45.9463710E-02
 33.6000000E-02 29.5809669E+01  0.             0.            -0.             0.             0.            -45.9463710E-02

       SO2            SO1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.             0.             0.             0.             0.             0.             0.             0.
  0.             0.             0.             0.             0.             0.             0.             0.
  0.             0.             0.             0.             0.             0.             0.             0.

       FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

  0.             0.             0.             0.             0.             0.             0.             0.

       FZM            LM             MM             NM

-30.3471767E-02  0.           -22.1607473E-01  0.

       VPCS

 38.7489900E+02

       TFFS
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

              INDSDF  2      CASE LROLL        STAGE  1      PAGE      17

 0.            0.
                                                    T(I)
           0.               0.
    SAC1
30.2764712E-03-23.1165513E-03 63.3345968E-02  0.            0.            90.5479600E-04  0.
    FLEX
    POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
    XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.             99.4718957E-02  0.             0.            -13.9810624E-03-28.8165118E+00  0.
28.9775555E+01  0.             0.            -67.9468564E-05 59.4117070E+00  0.             0.            -21.2477124E-04
20.0000000E-01  0.             10.6330259E-01  0.             0.            -60.2887769E-04-28.5380679E+00  0.
28.9784797E+01  0.             0.            -66.0806585E-05 59.4482754E+00  0.             0.            -12.6999361E-04
30.0000000E-01  0.             10.1410344E-01  0.             0.             76.3307855E-04-27.1715151E+00  0.
28.9778029E+01  0.             0.             69.8157902E-05 59.6324072E+00  0.             0.             16.5537344E-04
40.0000000E-01  0.             99.6433153E-02  0.             0.            -97.0273673E-04-26.1366245E+00  0.
28.9775552E+01  0.             0.            -99.1530823E-05 59.7728730E+00  0.             0.            -28.2621749E-04
                                                              FLARE
    AUTS
    ALPDES         PHIDES         TTO
11.5000000E+00  0.             0.
                                                       PITCH AUTOPILOT
    DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE
29.1249699E-01 12.5734103E-02 12.9187072E-01  0.             12.5734103E-02 29.1249699E-01
```

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                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                GENERALIZED COMPUTER PROGRAM

              INDSOF  2      CASE LROLL        STAGE  1      PAGE      61

     2SDF

62.1000000E-02 62.1000000E-02 18.2779011E+01  0.              72.8278655E-01 28.8804909E+01  0.              47.6178875E+00
 0.           -56.5839321E-03  0.             26.2185272E-02 29.2704183E+01 10.1803491E+01 29.2699998E+01  0.
-15.6534059E-01 93.6264033E-01  0.           -73.5941148E-01  0.            30.6411529E-02  0.              96.6905151E-01
 0.             0.            69.4071438E-01  0.            -52.7622423E+00 12.4671000E+04  0.              0.
 0.             0.

    LGEAR

    DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.            -27.3884855E+00-38.9549765E+02-78.8562277E+01  0.
13.1488589E-02 27.5133352E+04  0.            63.8888882E+03-42.3215235E+00-62.1944685E+03 62.3043014E+00 10.0750751E+03
13.1488589E-02 27.5133352E+04  0.            63.8888882E+03-42.3215235E+00-62.1944685E+03 62.3043014E+00 10.0750751E+03

    MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 29.2564904E+01  0.             0.            -0.             0.             0.            -48.3248881E-01
30.5490491E-03 18.6144325E-02 19.9022902E+02  0.            -65.1486407E+03 19.8975418E+02  0.             13.1488589E-02
30.5490491E-03 18.6144325E-02 19.9022902E+02  0.            -65.1486407E+03 19.8975418E+02  0.             13.1488589E-02

    SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

 0.             0.             0.             0.             0.             0.             0.             0.
-11.7341690E+00-48.8038364E-02 15.3555000E-01  0.             0.             0.            25.5096689E+01-29.2734080E+01
-11.7341690E+00-48.8038364E-02 15.3555000E-01  0.             0.             0.            25.5096689E+01-29.2734080E+01

    FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

25.8082436E+03  0.           -12.7777776E+04  0.            -28.6730913E+04  0.            25.8082436E+03  0.

    FZM            LM             MM             NM

-12.7227571E+04  0.           -2[illegible].6757725E+04  0.

     VPCS

38.7489900E+02

     TFFS

 0.             0.

                                                                T(I)
                 0.             0.

     SAC1

32.1718824E-03-66.4893942E-04 47.3079602E-02  0.             0.             17.5817250E-03  0.
```

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                                        SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                           GENERALIZED COMPUTER PROGRAM

                                 INDSDF  2      CASE LROLL         STAGE  1      PAGE      62

      FLEX

      POINT              XD2F             XD2I            YD2F            YD2T            ZD2F            ZD2T             XD1F
      XD1T               YD1F             YD1T            ZD1F            ZD1T            XD0F            YD3F             ZD0F

 10.0000000E-01   0.               68.4666886E-01  0.              0.             -10.6213103E+00-60.7731074E+00   0.
 28.8834377E+01   0.               0.            -38.1223422E-02 49.6509167E+00  0.              0.              94.0271317E-04
 20.0000000E-01   0.               67.4778087E-01  0.              0.             -84.7969118E-01-59.1051493E+00   0.
 28.8696456E+01   0.               0.            -33.1877891E-02 49.2711607E+00  0.              0.             -14.0727492E-06
 30.0000000E-01   0.               68.8317726E-01  0.              0.             -21.0819068E+00-74.0437875E+00   0.
 28.8775697E+01   0.               0.             30.7482825E-02 47.7647472E+00  0.              0.              66.8809979E-04
 40.0000000E-01   0.               70.6944073E-01  0.              0.              35.4803416E+00-19.2952814E+00   0.
 28.8835337E+01   0.               0.            -21.8590404E-02 45.5697519E+00  0.              0.             -75.5986953E-04
                                                                 LANDING ROLL
                                   ISS =  1            ILR = 1            IOS = 0           IBS = 1
      AUTS

      TI                 TR

 17.1000000E-02 45.0000000E-02

                                                                PITCH AUTOPILOT

      DELON              ALPHAE           ALPHD1          ALPD31          ALPHET          DELQDE

 30.2304646E-01 21.0562187E-02-73.5941148E-01  0.              21.0562187E-02 43.4154646E-01

INTEG RTN.      HT =    1.0000000E-03
INTEG RTN.      HT =    1.0000000E-03
INTEG RTN.      HT =    1.0000000E-03
INTEG RTN.      HT =    1.0000000E-03

      2SDF

 64.1000000E-02 64.1000000E-02 18.8632650E+01  0.               73.1777552E-01 28.8881821E+01  0.              46.9475045E+00
  0.           -57.3193224E-03  0.             26.2156285E-02 29.2671787E+01 10.1777854E+01 29.2665585E+01   0.
-19.0530149E-01 92.3369947E-01  0.            -57.5024101E-01  0.              37.3000049E-02  0.              96.0369922E-01
  0.              0.              59.7925932E-01  0.            -44.3912009E+00 12.4671000E+04  0.               0.
  0.              0.

      LGEAR

      DELTA              P                P2              FT              SR              SF              AA               FC2

  0.             35.2800000E+03   0.              0.             -64.3249163E-01-38.9549765E+02-78.8562277E+01   0.
 10.8317855E-02 26.2806182E+04   0.             48.3677210E+03-25.6507326E+00-47.1053210E+03 46.4188123E+00  22.0469100E+03
 10.8317855E-02 26.2806182E+04   0.             48.3677210E+03-25.6507326E+00-47.1053210E+03 46.4188123E+00  22.0469100E+03

      HUVP               VGPT             FTRK            FTRY            FTRZ            MA              MB               DDELTA
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H-19

ORIGINAL PAGE IS
OF POOR QUALITY

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                 INDSOF  2      CASE LROLL        STAGE  1      PAGE      63

 33.6000000E-02 29.2521242E+01  0.            0.                -0.            0.             0.             -40.3403380E-01
 58.4127470E-03 35.5844765E-02 28.9405380E+02 0.                -49.5449015E+03 29.6042066E+02 0.             10.8317855E-02
 58.4127470E-03 35.5844765E-02 28.9405380E+02 0.                -49.5449015E+03 29.6042066E+02 0.             10.8317855E-02
      SD2            SD1            S             S2D2              S2D1           S2             OMETD1         OMET

 0.             0.             0.             0.                0.             0.             0.             0.
-10.9550103E+00-72.1944281E-02 14.9342391E-01 0.                0.             0.             37.9541110E+01-28.6203900E+01
-10.9550103E+00-72.1944281E-02 14.9342391E-01 0.                0.             0.             37.9541110E+01-28.6203900E+01
      FTRA           FTRB           FTRC          MTX               MTY            MTZ            FXM            FYM

 22.2383791E+03  0.            -96.7354421E+03 0.               -13.7383671E+04 0.             22.2383791E+03 0.
      FZM            LM             MM            NM

-96.6558663E+03  0.            -13.6063712E+04 0.
      VPCS

 38.7489900E+02
      TFFS

  0.            0.

                                                                  T(I)
                 0.                  0.
      SAC1

 32.1393822E-03-56.9704078E-04 46.1265784E-02 0.                0.             19.1306562E-03 0.
      FLEX

      POINT          XD2F           XD2T          YD2F              YD2T           ZD2F           ZD2T           XD1F
      XD1T           YD1F           YD1T          ZD1F              ZD1T           XD0F           YD0F           ZD0F

 10.0000000E-01  0.            58.9038492E-01 0.                0.             31.3678564E-01-40.7668670E+00 0.
 28.8881784E+01  0.            0.            -44.7267271E-02    48.9454369E+00 0.             0.             65.0872589E-05
 20.0000000E-01  0.            58.8485351E-01 0.                0.             58.3634492E-01-38.1602575E+00 0.
 28.8772411E+01  0.            0.            -37.1974090E-02    48.5861306E+00 0.             0.            -75.4029150E-04
 30.0000000E-01  0.            59.9224620E-01 0.                0.            -12.9324976E+00-57.3578094E+00 0.
 28.8852122E+01  0.            0.            -83.6234967E-03    46.7011988E+00 0.             0.             86.4517888E-04
 40.0000000E-01  0.            60.5447266E-01 0.                0.             85.0873473E-01-36.2519358E+00 0.
 28.8882172E+01  0.            0.             27.0909251E-02    45.3654143E+00 0.             0.            -61.1222169E-04
                                                           LANDING ROLL
                          ISS =  1          ILR = 1             ICS = 0          IBS = 1
      AUTS
```

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                            GENERALIZED COMPUTER PROGRAM

                 INDSDF  2      CASE LROLL        STAGE  1      PAGE     64

     TI              TR
 17.1000000E-02 47.0000000E-02

                                                     PITCH AUTOPILOT

     DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

 30.2904646E-01 21.0562187E-02-57.5024101E-01  0.              21.0562187E-02 44.4654646E-01

INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03

      2SDF

 66.1000000E-02 66.1000000E-02 19.4485662E+01  0.              73.5777460E-01 28.8931806E+01  0.              46.4549595E+00
  0.            -57.0789022E-03  0.            26.2130117E-02 29.2642532E+01 10.1757389E+01 29.2635252E+01  0.
-20.6413184E-01 91.3394418E-01  0.           -39.5701252E-01  0.              40.4135131E-02  0.              95.3807895E-01
  0.              0.            43.1718725E-01  0.           -35.4467663E+00 12.4671000E+04  0.               0.
  0.              0.

     LGEAR

     DELTA           P               P2              FT              SR              SF              AA              FC2

  0.             35.2800000E+03  0.              0.              13.5609060E+00-38.9549765E+02-78.8562277E+01  0.
 79.7485390E-03 24.7787484E+04  0.              31.2633690E+03 55.8094456E-01-30.7477936E+03 18.9578574E+00 34.7049533E+03
 79.7485390E-03 24.7787484E+04  0.              31.2633690E+03 55.8094456E-01-30.7477936E+03 18.9578574E+00 34.7049533E+03

     HUVP            VGPT            FTRX            FTRY            FTRZ            HA              HB              DDELTA

 33.6000000E-02 29.2532878E+01  0.              0.              -0.              0.              0.             -48.3818660E-01
 83.0291031E-03 50.5797895E-02 26.6939812E+02  0.             -32.1501500E+03 28.0687602E+02  0.              79.7485390E-03
 83.0291031E-03 50.5797895E-02 26.6939812E+02  0.             -32.1501500E+03 28.0687602E+02  0.              79.7485390E-03

     SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

  0.              0.              0.              0.              0.              0.              0.              0.
-71.9041473E-01-90.5785885E-02 14.7701977E-01  0.              0.              0.              35.9855900E+01-27.8566322E+01
-71.9041473E-01-90.5785885E-02 14.7701977E-01  0.              0.              0.              35.9855900E+01-27.8566322E+01

     FTRA            FTRB            FTRC            HTX             HTY             HTZ             FXH             FYH

 15.9197474E+03  0.             -62.5267381E+03  0.             -77.6736544E+03  0.              15.9197474E+03  0.

     FZH             LH              MH              NH

-63.5096594E+03  0.             -77.0198697E+03  0.
```


ORIGINAL PAGE IS
OF POOR QUALITY

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.1012122E-03 -49.5283810E-04 45.2095608E-02 0. 0. 20.5249085E-03 0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000000E-01	0.	42.1406029E-01	0.	0.	85.2945214E-01	-28.2359282E+00	0.
28.8932214E+01	0.	0.	-31.6250896E-02	48.5740770E+00	0.	0.	-71.6088251E-04
20.0000000E-01	0.	42.7438247E-01	0.	0.	18.3651000E+00	-18.1721599E+00	0.
28.8823135E+01	0.	0.	-11.0876619E-02	48.3465991E+00	0.	0.	-12.7956221E-03
30.0000000E-01	0.	43.5497000E-01	0.	0.	92.2606502E-01	-26.1346324E+00	0.
28.8902380E+01	0.	0.	-11.0391654E-02	46.1825397E+00	0.	0.	59.4178459E-04
40.0000000E-01	0.	44.1226699E-01	0.	0.	-23.4238270E+00	-57.8713330E+00	0.
28.8931887E+01	0.	0.	89.5103318E-03	44.6989206E+00	0.	0.	-14.1993966E-04

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
17.1000000E-02	49.0000000E-02

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
30.2904646E-01	21.0562187E-02	-39.5701252E-01	0.	21.0562187E-02	45.5154646E-01

INTEG RTN. HT = 1.0000000E-03
INTEG RTN. HT = 1.0000000E-03
INTEG RTN. HT = 1.0000000E-03
INTEG RTN. HT = 1.0000000E-03

2SDF

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

                    INDSOF  2      CASE LROLL         STAGE  1      PAGE      66

 68.1000000E-02 68.1000000E-02 20.0338019E+01  0.               73.9924394E-01 28.8948013E+01  0.              46.1261444E+00
  0.                -56.1625577E-03  0.             26.2397897E-02 29.2606520E+01 10.1732222E+01 29.2599272E+01  0.
-20.5948773E-01 90.6987095E-01  0.            -25.3421840E-01  0.               40.3275483E-02  0.              94.7314606E-01
  0.              0.              27.7115257E-01  0.            -28.6024135E+00 12.4671000E+04  0.               0.
  0.              0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

  0.             35.2800000E+03  0.              0.             15.5449963E+00-38.9549765E+02-78.8562277E+01  0.
 55.4214872E-03 23.2179868E+04  0.             18.6590469E+03 12.8135961E+00-18.2453913E+03 15.2102330E+00 43.3294224E+03
 55.4214872E-03 23.2179868E+04  0.             18.6590468E+03 12.8135961E+00-18.2453913E+03 15.2102330E+00 43.3294224E+03

     HUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 33.6000000E-02 29.2555169E+01  0.             0.             -0.              0.             0.            -48.3757375E-01
 97.3389912E-03 59.2838668E-02 18.7117868E+02  0.            -19.2292475E+03 20.1306737E+02  0.             55.4214872E-03
 97.3389912E-03 59.2838668E-02 18.7117858E+02  0.            -19.2292475E+03 20.1306737E+02  0.             55.4214872E-03

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.              0.              0.             0.              0.             0.             0.             0.
-37.1143913E-01-10.1209497E-01 14.5772370E-01  0.              0.             0.             25.8085561E+01-27.2371260E+01
-37.1143913E-01-10.1209497E-01 14.5772370E-01  0.              0.             0.             25.8085561E+01-27.2371260E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

 10.0210262E+03  0.            -37.3180936E+03  0.            -42.4109999E+03  0.             10.0210262E+03  0.

     FZM            LM             MM             NM

-38.1090417E+03  0.            -41.9508532E+03  0.

     VPGS

 38.7489900E+02

     TFFS

  0.             0.

                                                   T(I)

                  0.             0.

     SAC1

 32.0609164E-03-43.9375172E-04 44.5380575E-02  0.              0.             21.7746800E-03  0.

     FLEX
```

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ORIGINAL PAGE IS
OF POOR QUALITY

```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                  GENERALIZED COMPUTER PROGRAM

                    INDSOF  2      CASE LROLL         STAGE  1      PAGE      67

     POINT            XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
     XD1T             YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.              26.5194196E-01  0.              0.              82.4253550E-01-22.8201092E+00  0.
28.8948673E+01  0.              0.             -14.2862451E-02 48.3795529E+00  0.              0.             -11.7417473E-03
20.0000000E-01  0.              27.4243689E-01  0.              0.              14.4432741E+00-16.1881451E+00  0.
28.8841002E+01  0.              0.              24.8585609E-02 48.3450978E+00  0.              0.             -11.2861483E-03
30.0000000E-01  0.              27.9536024E-01  0.              0.              95.1141237E-01-18.9289262E+00  0.
28.8919050E+01  0.              0.              12.8933439E-02 46.0956508E+00  0.              0.              61.1889375E-04
40.0000000E-01  0.              29.2164424E-01  0.              0.             -22.1338210E+00-48.8718440E+00  0.
28.8948289E+01  0.              0.             -43.4347019E-02 43.8758765E+00  0.              0.             -49.1257914E-04

                                                          LANDING ROLL
                              ISS =  1          ILR = 1           ICS = 0           IBS = 1
     AUTS

     TI               TR

17.1000000E-02 51.0000000E-02

                                                          PITCH AUTOPILOT

     DELQN            ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

30.2904646E-01 21.0562187E-02-25.3421840E-01  0.              21.0562187E-02 46.5654646E-01

INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03

     2SOF

70.1000000E-02 70.1000000E-02 20.6189596E+01  0.                              74.3938058E-01 28.8938328E+01  0.              45.9182552E+00
 0.           -54.8023739E-03  0.              26.2060075E-02 29.2564256E+01 10.1702716E+01 29.2557836E+01  0.
-19.3812782E-01 90.2990597E-01  0.             -15.0825969E-01  0.              37.9566097E-02  0.              94.0953166E-01
 0.              0.              17.9692703E-01  0.             -23.8543818E+00 12.4671000E+04  0.              0.
 0.              0.

     LGEAR

     DELTA            P               P2              FT              SR              SF              AA              FC2

 0.              35.2800000E+03  0.              0.              19.5333695E-01-38.9549765E+02-78.8562277E+01  0.
37.0160437E-03 21.7387154E+04  0.              10.4988327E+03-22.5909581E-01-96.3104105E+02 31.9089490E+00 48.1739875E+03
37.0160437E-03 21.7387154E+04  0.              10.4988327E+03-22.5909581E-01-96.3104105E+02 31.9089490E+00 48.1739875E+03
     HJVP             VGPT            FTRX            FTRY            FTRZ            HA              HB              DDELTA

33.6500000E-02 29.2533044E+01  0.              0.             -0.              0.              0.             -48.3122901E-01
12.8697577E-02 78.3996027E-02 13.9944945E+02  0.             -10.8739379E+03 15.3132511E+02  0.              37.0160437E-03
```

```
                    SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                         GENERALIZED COMPUTER PROGRAM
              INDSDF  2      CASE LROLL        STAGE  1      PAGE      68

12.8697577E-02 78.3996627E-02 13.9944945E+02  0.        -10.8739379E+03 15.3132511E+02  0.          37.0160437E-03
    SD2            SD1            S             S2D2          S2D1           S2             OMETD1        OMET

 0.             0.             0.             0.            0.             0.             0.             0.
-20.9124491E-01-10.6717616E-01 14.3687757E-01  0.            0.             0.            19.6323732E+01-26.7940119E+01
-20.9124491E-01-10.6717616E-01 14.3687757E-01  0.            0.             0.            19.6323732E+01-26.7940119E+01
    FTRA           FTRB           FTR3          HTX           HTY            HTZ            FXH           FYH

63.1680171E+02  0.            -2..9976653E+03  0.          -18.0866880E+03  0.            63.1680171E+02  0.
    FZH            LH             HH            NH

-20.5318193E+03  0.            -18.1690656E+03  0.
    VPCS

38.7489900E+02
    TFFS

 0.             0.

                                                          T(I)
               0.             3.
    SAC1

32.0214541E-03-39.5826770E-04 44.0490521E-02  0.            0.            22.9158559E-03  0.
    FLEX
    POINT          XD2F           XD2T          YD2F          YD2T           ZD2F           ZD2T          XD1F
    XD1T           YD1F           YD1T          ZD1F          ZD1T           XD0F           YD0F          ZD0F

10.0000000E-01  0.            16.6946822E-01  0.            0.            34.2032401E-01-23.7162357E+00  0.
28.8933050E+01  0.             0.           -15.4642922E-03 48.2410273E+00  0.             0.           -13.1666354E-03
20.0000000E-01  0.            17.9795598E-01  0.            0.           -32.2558120E-01-29.7845367E+00  0.
28.8833536E+01  0.             0.            37.1352088E-02 48.2122554E+00  0.             0.           -44.8662561E-04
30.0000000E-01  0.            18.3156139E-01  0.            0.           -10.3734877E+00-34.0110324E+00  0.
28.8909809E+01  0.             0.            12.6006293E-02 45.8886956E+00  0.             0.            93.5569417E-04
40.0000000E-01  0.            19.5626427E-01  0.            0.            10.2196316E+00-11.1474792E+00  0.
28.8939213E+01  0.             0.           -57.9108470E-02 43.5672051E+00  0.             0.           -16.1506179E-03
                                                     LANDING ROLL
                          ISS =  1         ILR = 1          ICS = 0          IBS = 1
    AUTS

    TI             TR
```

```
38.7489900E+02
        TFFS
 0.              0.

                                                              T(I)
                  0.                    0.
        SAC1
31.9848926E-03-36.1983351E-04 43.6987692E-02  0.              0.              23.9731442E-03  0.
        FLEX
      POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.              97.0243337E-02  0.              0.             -73.1327717E-01-31.5580357E+00  0.
28.8912536E+01  0.              0.             -49.6176095E-03 48.0172686E+00  0.              0.             -13.4519269E-03
20.0000000E-01  0.              11.4917580E-01  0.              0.             -16.7565586E+00-40.3057253E+00  0.
28.8810000E+01  0.              0.              14.7830068E-02 47.8121304E+00  0.              0.              11.6566985E-04
30.0000000E-01  0.              11.6104793E-01  0.              0.             -14.8339434E+00-34.8437167E+00  0.
28.8804291E+01  0.              0.             -17.5585320E-02 45.4755215E+00  0.              0.              90.1420992E-04
40.0000000E-01  0.              11.8457233E-01  0.              0.              33.5923133E+00 16.2803981E+00  0.
28.8913075E+01  0.              0.             -86.2943275E-03 43.9990078E+00  0.              0.             -23.6065469E-03
                                                                     LANDING ROLL
                                ISS =  1          ILR = 1          ICS = 0          IBS = 1
       AUTS
       TI              TR
17.1000000E-02 55.0000000E-02
                                                                  PITCH AUTOPILOT
       DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE
30.2904646E-01 21.0562187E-02-76.0178610E-02  0.              21.0562187E-02 48.6654646E-01
INTEG RTN.      HT =   1.0000000E-03
INTEG RTN.      HT =   1.0000000E-03
INTEG RTN.      HT =   1.0000000E-03
INTEG RTN.      HT =   1.0000000E-03
        2SDF
74.1000000E-02 74.1000000E-02 21.7890139E+01  0.              75.0830519E-01 28.8867584E+01  0.              45.7522395E+00
 0.            -51.1927319E-03  0.              26.1974251E-02 29.2468372E+01 10.1635859E+01 29.2464680E+01  0.
-14.6966600E-01 90.0002100E-31  0.             -19.9883486E-02  0.              28.7915016E-02  0.              92.8793601E-01
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                    INDSDF  2     CASE LROLL        STAGE  1     PAGE     71
 0.              0.              18.0248735E-02  0.              -18.4225605E+00 12.4671000E+04  0.              0.
 0.              0.
      LGEAR
      DELTA           P               P2              FT              SR              SF              AA              FC2
 0.              35.2800000E+03  0.              0.              -16.5788019E-01-38.9549765E+02-78.8562277E+01  0.
 18.2019808E-04  19.1724125E+04  0.              14.3985854E+01  19.5192103E+00  21.6134880E+01  13.2417435E+00  51.4680970E+03
 18.2019808E-04  19.1724125E+04  0.              14.3985854E+01  19.5192103E+00  21.6134880E+01  13.2417435E+00  51.4680970E+03
      MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA
 33.6000000E-02  29.2353357E+01  0.              0.              -0.             0.              0.              -48.1894118E-01
 33.6000000E-02  43.1046278E-01  51.8722932E+00  0.              -15.4381825E+01  58.5861138E+00  0.              18.2019808E-04
 33.6000000E-02  43.1046278E-01  51.8722932E+00  0.              -15.4381825E+01  58.5861138E+00  0.              18.2019808E-04
      SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET
 0.              0.              0.              0.              0.              0.              0.              0.
 10.0876391E-01-11.0305933E-01  13.9308167E-01  0.              0.              0.              75.1104023E-01-26.2592978E+01
 10.0876391E-01-11.0305933E-01  13.9308167E-01  0.              0.              0.              75.1104023E-01-26.2592978E+01
      FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM
 15.2217693E+01  0.              -28.7971708E+01  0.              21.2927187E+01  0.              15.2217693E+01  0.
      FZM             LM              MM              NM
-49.7638287E+01  0.              -25.6775193E+02  0.
       VPGS
 38.7489900E+02
       TFFS
 0.              0.
                                                                  T(I)
                 0.              0.
       SAC1
 31.9527665E-03-33.4850903E-04  43.4528884E-02  0.              0.              24.9657752E-03  0.
       FLEX
      POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F
```

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```
10.0000000E-01  0.   93.9492732E-03  0.                0.              -11.2839123E+00-33.7397308E+00  0.
28.8868426E+01  0.    0.            -26.4411418E-02  47.6720530E+00    0.               0.            -16.4486692E-03
20.0000000E-01  0.   28.6877577E-02  0.                0.              -11.6710242E+00-33.4150007E+00  0.
28.8769425E+01  0.    0.            -16.9101043E-02  47.3791484E+00    0.               0.             77.8881037E-05
30.0000000E-01  0.   26.5568752E-02  0.                0.               59.3991323E-01-12.2155809E+00  0.
28.8841309E+01  0.    0.            -28.6777034E-02  45.3201432E+00    0.               0.             36.7752408E-04
40.0000000E-01  0.   21.5692812E-02  0.                0.               14.0120145E+00-13.5399271E-01  0.
28.8868566E+01  0.    0.             46.3736110E-02  44.5607457E+00    0.               0.            -19.1665537E-03
```

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
17.1000000E-02	57.0000000E-02

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
30.2934646E-01	21.0562187E-02	-19.9883486E-02	0.	21.0562187E-02	49.7154646E-01

```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM

                      INDSOF  2     CASE LROLL        STAGE  1      PAGE     169

                                                   LANDING ROLL
      AUTS                    ISS =  1          ILR = 1          ICS = 0          IBS = 1

      TI              TR

 17.1000000E-02 18.6450000E-01

                                                  PITCH AUTOPILOT

      DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE

 30.2904646E-01 21.0562187E-02-11.1915567E+00  0.                21.0562187E-02 80.0000000E-01

INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03
INTEG RTN.       HT =  1.0000000E-03

       2SDF

 20.5550000E-01 20.5550000E-01 60.0413284E+01  0.                69.8592229E-01 28.9889488E+01  0.                69.3210286E-01
  0.           -18.9451404E-02  0.              25.9738018E-02 28.9972360E+01 99.9100078E+00 28.9972259E+01  0.
 24.2357939E-02 13.0984808E-01  0.             -11.1670868E+00  0.             -47.8868178E-03  0.                13.2196045E-01
  0.             0.            -14.0517111E-01  0.             -33.7979475E+00 12.4671000E+04  0.                 0.
  0.             0.

      LGEAR

      DELTA           P               P2              FT              SR              SF              AA              FC2

 81.7922661E-03 57.6562945E+03  0.              12.8245160E+03-12.5554962E+00-12.6709702E+03 31.0821374E+00-59.0653689E+02
 13.2834932E-02 24.4486291E+04  0.              66.0766017E+03-16.9343500E+00-65.5287395E+03 20.1461525E+00-16.1707501E+00
 13.2834932E-02 24.4486291E+04  0.              66.0766017E+03-16.9343500E+00-65.5287095E+03 20.1461525E+00-16.1707501E+00

      MJVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 33.6000000E-02 15.2671276E+01-42.7702158E+02  0.             -12.7292309E+03-41.3213506E+02  0.                81.7922661E-03
 91.7800560E-05 55.2299775E-04-60.6603994E+00  0.             -66.0927935E+03-60.5642568E+00  0.                13.2834932E-02
 91.7800560E-05 55.2299775E-04-60.6603994E+00  0.             -66.0927935E+03-60.5642568E+00  0.                13.2834932E-02

      SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

-13.6387954E+00 65.7133448E-01 56.7512057E-02  0.              0.              0.             -17.2172294E+02-14.0772319E+01
-28.9536341E+00 19.0859036E-02 14.7314386E-01  0.              0.              0.             -77.6464830E-01-28.9298056E+01
-28.9536341E+00 19.0859036E-02 14.7314386E-01  0.              0.              0.             -77.6464830E-01-28.9298056E+01
      FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

-10.5391220E+02  0.            -14.4977719E+04  0.              60.6772899E+03  0.             -10.5391220E+02  0.
```

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ORIGINAL PAGE IS
OF POOR QUALITY

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

```
                    INDSDF  2      CASE LROLL        STAGE  1      PAGE    170

     FZH             LH              MH              NH
-14.5736198E+04  0.          59.4568336E+03  0.
     VPCS
38.7489900E+02
     TFFS
 0.              0.

                 0.                0.                         T(I)
     SAC1
32.4577088E-03 27.3828659E-03-92.1238154E-03  0.              0.              66.8353282E-04  0.
     FLEX
     POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
     XD1T            YD1F            YD1T            Z01F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.           -27.6738317E-01  0.               0.          -10.0066779E+00-46.4665700E+00  0.
28.9890028E+01  0.                0.         -44.6954232E-02 14.5684149E+00  0.               0.          -28.4720180E-04
20.0000000E-01  0.           -24.5688827E-01  0.               0.          -86.5750179E-01-44.7179974E+00  0.
28.9526555E+01  0.                0.         -23.1539479E-02 13.3471438E+00  0.               0.          -14.9213231E-04
30.0000000E-01  0.           -14.6057697E-01  0.               0.          -15.4730238E+00-49.1117595E+00  0.
28.9791440E+01  0.                0.          50.0530831E-02 68.9484367E-01  0.               0.           79.5512680E-04
40.0000000E-01  0.           -74.4153009E-03  0.               0.           31.6113317E+00-16.4817856E-02  0.
28.9892419E+01  0.                0.         -45.1887502E-02 35.4626263E-02  0.               0.          -15.4673291E-03
                                                             LANDING ROLL
                             ISS =   1          ILR = 1               ICS = 0             IBS = 1
     AUTS
     TI              TR
17.1600000E-02 18.8450000E-01

                                                            PITCH AUTOPILOT
     DELQN           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELQDE
36.2904646E-01 21.0562187E-02-11.1670868E+00  0.              21.0562187E-02 80.0000000E-01
INTEG RTN.       HT =   1.0000000000E-03
INTEG RTN.       HT =   1.0000000000E-03
INTEG RTN.       HT =   1.0000000000E-03
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 171

INTEG RTN. HT = 1.0000000E-03

2SOF

```
20.7550000E-01 20.7550000E-01 60.6212283E+01  0.                    69.8134794E-01 28.9870096E+01  0.                    58.1074009E-01
 0.           -18.8173998E-02  0.                  25.9698576E-02 28.9928331E+01 99.8796830E+00 28.9928250E+01  0.
21.6469305E-02 11.4839821E-01  0.                 -10.9606386E+00  0.            -42.7785508E-03  0.                    11.0561944E-01
 0.             0.            -14.1652706E-01  0.                 -33.1442871E+00 12.4671000E+04  0.                     0.
 0.             0.
```

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
84.7939415E-03	67.3300377E+03	0.	13.3803844E+03	-44.2329979E-01	-13.2625665E+03	23.8497817E+00	-54.0718812E+02
13.3085494E-02	24.4407720E+04	0.	66.2500905E+03	-23.5957401E+00	-64.9188550E+03	48.9499131E+00	26.4636728E+01
13.3085494E-02	24.4407720E+04	0.	66.2500905E+03	-23.5957401E+00	-64.9188550E+03	48.9499131E+00	26.4636728E+01

HUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	11.9337153E+01	-44.6767570E+02	0.	-13.2966539E+03	-43.0293355E+02	0.	84.7959415E-03
50.9470086E-04	30.6537193E-03	33.7620439E+01	0.	-66.2689427E+03	33.7003739E+01	0.	13.3085494E-02
50.9470086E-04	30.6537193E-03	33.7620439E+01	0.	-66.2689427E+03	33.7003739E+01	0.	13.3085494E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
-12.7415281E+00	62.8742550E-01	69.6058080E-02	0.	0.	0.	-17.9288898E+02	-17.5845441E+01
-68.1383695E-01	-79.0960645E-03	14.7305034E-01	0.	0.	0.	43.2052230E+00	-28.9367462E+01
-68.1383695E-01	-79.0960645E-03	14.7305034E-01	0.	0.	0.	43.2052230E+00	-28.9367462E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
-97.7773140E+01	0.	-14.5880565E+04	0.	80.6481770E+03	0.	-97.7778140E+01	0.

FZM	LM	MM	NM
-14.5363609E+04	0.	85.2286049E+03	0.

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

H-37

ORIGINAL PAGE IS
OF POOR QUALITY

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

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                    INDSDF  2      CASE LROLL        STAGE  1      PAGE    172
32.4624287E-03 28.1404872E-03-10.3796477E-02  0.            0.            69.8650938E-04  0.
      FLEX
     POINT          XD2F          XD2T          YD2F          YD2T          ZD2F          ZD2T          XD1F
     XD1T           YD1F          YD1T          ZD1F          ZD1T          XD0F          YD0F          ZD0F
10.0000000E-01  0.            -27.7224516E-01  0.            0.            11.6020426E+00-24.9473108E+00  0.
28.9872383E+01  0.            0.            -41.0614358E-02 13.4246226E+00  0.            0.            -12.1627660E-03
20.0000000E-01  0.            -23.7580276E-01  0.            0.            -58.1079965E-02-36.5930273E+00  0.
28.9511033E+01  0.            0.            -34.3806872E-02 12.0651897E+00  0.            0.            -75.1315033E-04
30.0000000E-01  0.            -12.9740044E-01  0.            0.            -22.8208643E+00-55.7566329E+00  0.
28.9771063E+01  0.            0.            61.2812503E-03 53.3814132E-01  0.            0.            13.7911403E-03
40.0000000E-01  0.            -30.6224987E-02  0.            0.            17.6827473E+00-12.8811427E+00  0.
28.9873594E+01  0.            0.            84.8105792E-03-18.5502339E-02  0.            0.            -18.6019265E-03
                                                  LANDING ROLL
                          ISS =  1        ILR = 1         ICS = 0         IBS = 1
      AUTS
      TI             TR
17.1000000E-02 19.0450000E-01
                                                  PITCH AUTOPILOT
     DELQN          ALPHAE        ALPHD1        ALPDD1        ALPHET        DELQDE
30.2934646E-01 21.0562187E-02-10.9606386E+00  0.            21.0562187E-02 80.0000000E-01
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
INTEG RTN.      HT =  1.0000000E-03
      2SDF
20.9550000E-01 20.9550000E-01 61.2010446E+01  0.            69.7712021E-01 20.9849584E+01  0.            47.2138386E-01
 0.           -18.6145607E-02  0.            25.9662478E-02 28.9888035E+01 09.8519337E+00 28.9887957E+01  0.
21.2873019E-02 93.3213165E-02  0.           -10.9340196E+00  0.           -42.0731299E-03  0.            89.1139243E-02
 0.             0.           -15.8204176E-01  0.           -31.5481060E+00 12.4671000E+04  0.             0.
 0.             0.
      LGEAR
     DELTA          P             P2            FT            SR            SF            AA            FC2
90.9370315E-03 80.2981199E+03  0.            14.5466983E+03 82.8204754E-01-14.4480851E+03 19.9621929E+00-51.1812095E+02
12.8217654E-02 24.1699563E+04  0.            62.8546455E+03 17.5380997E-01-62.1616097E+03 25.4831275E+00 23.0253053E+02
12.8217654E-02 24.1699563E+04  0.            62.8546455E+03 17.5380997E-01-62.1616097E+03 25.4831275E+00 23.0253053E+02
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 173

MUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	84.8373344E+00	-48.6286691E+02	0.	-14.4728182E+03	-46.5366476E+02	0.	90.9370315E-03
94.0745475E-04	56.5969235E-03	59.1460308E+01	0.	-62.8714487E+03	59.3253820E+01	0.	12.8217654E-02
94.0745475E-04	56.5969235E-03	59.1460308E+01	0.	-62.8714487E+03	59.3253820E+01	0.	12.8217654E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
-39.2586812E-01	61.1765500E-01	81.9600129E-02	0.	0.	0.	-19.3902698E+02	-21.2994445E+01
-49.3317105E-01	-23.3309550E-02	14.6978958E-01	0.	0.	0.	76.0581821E+00	-28.7959953E+01
-49.3317105E-01	-23.3309550E-02	14.6978958E-01	0.	0.	0.	76.0581821E+00	-28.7959953E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
-14.9877010E+02	0.	-14.0255930E+04	0.	13.8194269E+04	0.	-14.9877010E+02	0.

FZM	LM	MM	NM
-14.0646100E+04	0.	14.0025077E+04	0.

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.4667223E-03	28.8992745E-03	-11.5017093E-02	0.	0.	72.6257734E-04	0.

FLEX

POINT / XD1T	XD2F / YD1F	XD2T / YD1T	YD2F / ZD1F	YD2T / ZD1T	ZD2F / XD0F	ZD2T / YD0F	XD1F / Z00F
10.0000000E-01	0.	-30.3669944E-01	0.	0.	10.2404124E+00	-26.2129758E+00	0.
28.9852881E+01	0.	0.	-14.9858384E-02	12.5137442E+00	0.	0.	-17.7110318E-03
20.0000000E-01	0.	-24.9453289E-01	0.	0.	11.7544384E+00	-23.8920966E+00	0.
28.9495341E+01	0.	0.	-22.5647991E-02	11.0263380E+00	0.	0.	-13.6255282E-03
30.0000000E-01	0.	-13.5220749E-01	0.	0.	83.0952074E-02	-30.3999241E+00	0.
28.9752596E+01	0.	0.	-19.1919157E-02	40.0105886E-01	0.	0.	11.6628068E-03
40.0000000E-01	0.	-52.4762158E-02	0.	0.	-98.7216929E-01	-37.6889354E+00	0.
28.9852436E+01	0.	0.	16.4735780E-02	-11.3258211E-01	0.	0.	-15.1588612E-03

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 174

AUTS

TI	TR
17.1000000E-02	19.2450000E-01

PITCH AUTOPILOT

DELQN	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
30.2944646E-01	21.0562187E-02	-10.5340196E+00	0.	21.0562187E-02	80.0000000E-01

```
INTEG RTN.    HT =  1.0000000E-03
INTEG RTN.    HT =  1.0000000E-03
INTEG RTN.    HT =  1.0000000E-03
INTEG RTN.    HT =  1.0000000E-03
```

2SDF

21.1330000E-01	21.1300000E-01	61.7083148E+01	0.	69.7323817E-01	28.9823225E+01	0.	38.0240418E-01
0.	-18.3812837E-02	0.	25.9626763E-02	28.9848167E+01	99.8244818E+00	28.9848073E+01	0.
23.2964272E-02	75.1662359E-02	0.	-10.2555551E+00	0.	-46.0508458E-03	0.	70.5611107E-02
0.	0.	-21.5084137E-01	0.	-30.8078924E+00	12.4671600E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
10.0140296E-02	36.2956605E+03	0.	16.3314726E+03	11.2671449E+00	-16.2324229E+03	20.0505472E+00	-50.7333807E+02
12.5560121E-02	23.8047507E+04	0.	61.0332972E+03	18.5921402E+00	-60.6217465E+03	15.1328382E+00	29.4036920E+02
12.5560121E-02	23.8047507E+04	0.	61.0332972E+03	18.5921402E+00	-60.6217465E+03	15.1328382E+00	29.4036920E+02

MUVP	VGPT	FTRX	FTRY	FTRZ	HA	HB	DDELTA
33.6000000E-02	52.9389554E+00	-54.6517533E+02	0.	-16.2654028E+03	-51.7976422E+02	0.	10.0140296E-02
12.0567923E-04	72.5302373E-04	73.5932524E+00	0.	-61.0383321E+03	74.0119891E+00	0.	12.5560121E-02
12.0567923E-04	72.5302373E-04	73.5932524E+00	0.	-61.0383321E+03	74.0119891E+00	0.	12.5560121E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
-85.3068083E-02	60.9023449E-01	92.6932390E-02	0.	0.	0.	-21.5823509E+02	-24.8716125E+01
15.5341814E-01	-26.3651805E-02	14.6527482E-01	0.	0.	0.	94.8871655E-01	-28.7127893E+01
15.5341814E-01	-26.3651805E-02	14.6527482E-01	0.	0.	0.	94.8871655E-01	-28.7127893E+01

FTRA	FTRB	FTRC	HTX	HTY	HTZ	FXH	FYH
-36.1390096E+02	0.	-13.8398067E+04	0.	19.7218387E+04	0.	-36.1390396E+02	0.

FZH	LH	MH	NH

-13.9307929E+04 0. 19.7660530E+04 0.

VPCS

38.7489900E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.4711047E-03 29.5587475E-03-12.4399990E-02 0. 0. 74.8161385E-04 0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000000E-01	0.	-35.7024372E-01	0.	0.	-22.2743677E-02	-37.5187541E+00	0.
28.9826780E+01	0.	0.	-68.3458128E-03	11.5767454E+00	0.	0.	-19.3433300E-03
20.0000000E-01	0.	-30.5649040E-01	0.	0.	15.2820319E+00	-20.9255690E+00	0.
28.9473759E+01	0.	0.	25.5442167E-03	10.2767092E+00	0.	0.	-15.4678876E-03
30.0000000E-01	0.	-19.7463728E-01	0.	0.	16.8343189E+00	-13.5591278E+00	0.
28.9727805E+01	0.	0.	-36.8352018E-04	32.7693659E-01	0.	0.	95.3201822E-04
40.0000000E-01	0.	-10.0892534E-01	0.	0.	-21.3242727E+00	-47.2153947E+00	0.
28.9825916E+01	0.	0.	-14.0614410E-02	-22.8148590E-01	0.	0.	-14.6501842E-03

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
17.1000000E-02	19.4200000E-01

PITCH AUTOPILCT

DELQN	ALPHAE	ALPHO1	ALPOD1	ALPHET	DELQDE
30.2904646E-01	21.0562187E-02	-10.2555551E+00	0.	21.0562187E-02	80.0000000E-01

STAGE ON--INCR. DELTA1

PRINT .05
AMAXER .01
DELTS .01
INDSTF 1
TRA

2SDF

21.1300000E-01	21.1300000E-01	61.7083148E+01	0.	69.7321817E-01	28.9823225E+01	0.	38.0240410E-01
0.	-18.3812837E-02	0.	25.9626763E-02	28.9849167E+01	99.8244818E+00	28.9848073E+01	0.
23.2964272E-02	75.1662359E-02	0.	-10.2555551E+00	0.	-46.0508458E-03	0.	79.5611107E-02
0.	0.	-21.5084137E-01	0.	-30.8078924E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
10.0140296E-02	96.2956605E+03	0.	16.3314726E+03	11.2671449E+00	-16.2324229E+03	20.0505472E+00	-50.7333807E+02
12.5560121E-02	23.8047507E+04	0.	61.0332972E+03	18.5921402E+00	-60.6217465E+03	15.1328382E+00	29.4036920E+02
12.5560121E-02	23.8047507E+04	0.	61.0332972E+03	18.5921402E+00	-60.6217465E+03	15.1328382E+00	29.4036920E+02

MJVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	52.3365554E+00	-54.6517533E+02	0.	-16.2654028E+03	-51.7976422E+02	0.	10.0140296E-02
12.0567923E-04	72.5302373E-04	73.5932524E+00	0.	-61.0383321E+03	74.0119891E+00	0.	12.5560121E-02
12.0567923E-04	72.5302373E-04	73.5932524E+00	0.	-61.0383321E+03	74.0119891E+00	0.	12.5560121E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
-85.3868383E-02	60.9023449E-01	92.6532330E-02	0.	0.	0.	-21.5823509E+02	-24.8716125E+01
15.5341814E-01	-26.3651805E-02	14.6527482E-01	0.	0.	0.	94.8871655E-01	-28.7127893E+01
15.5341814E-01	-26.3651805E-02	14.6527482E-01	0.	0.	0.	94.8871655E-01	-28.7127893E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
-36.1390096E+02	0.	-13.8398067E+04	0.	19.7210387E+04	0.	-36.1390096E+02	0.

FZM	LM	MM	NM
-13.9307929E+04	0.	19.7660530E+04	0.

VPCS

38.7489960E+02

TFFS

0. 0.

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                                                           T(I)
              0.                  0.

      SAC1

32.4711047E-03 29.5587475E-03-12.4390990E-02  0.              0.             74.8161385E-04  0.
      FLEX

    POINT           XD2F             XD2T             YD2F             YD2T             ZD2F             ZD2T             XD1F
    XD1T            YD1F             YD1T             ZD1F             ZD1T             XD0F             YD0F             ZD0F

10.0000000E-01  0.              -35.7024372E-01  0.               0.              -22.2740677E-02-37.5187541E+00  0.
28.9820780E+01  0.                0.            -68.3458128E-03 11.5767454E+00  0.               0.             -19.3433300E-03
20.0000000E-01  0.              -30.5649040E-01  0.               0.               15.2820319E+00-20.9255690E+00  0.
28.9473759E+01  0.                0.             25.5442167E-03 10.2767092E+00  0.               0.             -15.4678876E-03
30.0000000E-01  0.              -19.7463728E-01  0.               0.               16.8343189E+00-13.5591278E+00  0.
28.9727805E+01  0.                0.            -36.8352018E-04 32.7693659E-01  0.               0.              95.3201822E-04
40.0000000E-01  0.              -10.3892534E-01  0.               0.              -21.3242727E+00-47.2153947E+00  0.
28.9825918E+01  0.                0.            -14.0614410E-02-22.8148590E-01  0.               0.             -14.6561842E-03
                                                           LANDING ROLL
                             ISS =  1          ILR = 1            ICS = 0          IBS = 1
    AUTS

    TI              TR

17.1000000E-02 19.4200000E-01

                                                         PITCH AUTOPILOT

    DELQN           ALPHAE           ALPHD1           ALPDD1           ALPHET           DELQDE

30.2904646E-01 21.0562187E-02-10.2555551E+00  0.               21.0562187E-02 80.0000000E-01

INTEG RTN.      HT =   4.0000000E-03
INTEG RTN.      HT =   4.0000000E-03
INTEG RTN.      HT =   4.0000000E-03
INTEG RTN.      HT =   4.0000000E-03
INTEG RTN.      HT =   2.0000000E-03
     2SDF

21.6300000E-01 21.6300000E-01 63.1572389E+01  0.               69.6062074E-01 28.9736126E+01  0.              12.3691956E-01
 0.           -17.1366115E-02  0.             25.9528758E-02 28.9738766E+01 99.7491772E+00 28.9738653E+01  0.
25.6417159E-02 24.4601325E-02  0.            -98.2066649E-01  0.              -50.7058194E-03  0.              19.3894879E-02
 0.             0.            -12.6788353E-01  0.              -32.1912305E+00 12.4671000E+04  0.               0.
 0.             0.

    LGEAR
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H-37

ORIGINAL PAGE IS
OF POOR QUALITY

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                   INDSOF  2     CASE LROLL       STAGE  1      PAGE     178

      DELTA             P                P2               FT               SR               SF               AA               FC2

 14.8816077E-02 26.9111151E+04  0.                26.2864463E+03-24.3183405E+00-26.3465149E+03-12.1596274E+00-31.0675270E+02
 12.6227975E-02 23.1584345E+04  0.                61.4994761E+03-22.1256730E+00-60.2529306E+03 45.6887580E+00 15.8192198E+02
 12.6227975E-02 23.1584345E+04  0.                61.4954761E+03-22.1256730E+00-60.2529306E+03 45.6887580E+00 15.8192198E+02

      MUVP              VGPT             FTRX             FTRY             FTRZ             MA               MB              DDELTA

 60.6192112E-03 36.4579602E-02-15.9314594E+02  0.               -26.2812054E+03-14.3239851E+02  0.               14.8816077E-02
 99.0297682E-04 59.5659628E-03 60.9012171E+01  0.               -61.4978892E+03 61.2070645E+01  0.               12.6227975E-02
 99.0297682E-04 59.5659628E-03 60.9012171E+01  0.               -61.4978892E+03 61.2070645E+01  0.               12.6227975E-02

      SD2               SD1              S                S2D2             S2D1             S2              OMETD1            OMET

-68.6517830E+01 47.6585094E-01 12.1556005E-01  0.                0.               0.              -59.6832713E+01-32.0675815E+01
-86.1073074E-01-19.3384805E-02 14.5693553E-01  0.                0.               0.               78.4705955E+00-28.7334419E+01
-86.1073074E-01-19.3384805E-02 14.5693553E-01  0.                0.               0.               78.4705955E+00-28.7334419E+01

      FTRA              FTRB             FTRC             MTX              MTY              MTZ              FXM              FYM

 13.0048424E+01  0.              -14.9277398E+04  0.               57.3297205E+04  0.               13.0048424E+01  0.

      FZM               LM               MM               NM

-14.8770938E+04  0.               58.5663346E+04  0.

      VPCS

 38.7489900E+02

      TFFS

  0.             0.

                                                                   TIII

                 0.                0.

      SAC1

 32.4817894E-03 31.4967163E-03-15.0125452E-02  0.                0.               80.2509151E-04  0.

      FLEX

      POINT             XD2F             XD2T             YD2F             YD2T             ZD2F             ZD2T             XD1F
      XD1T              YD1F             YD1T             ZD1F             ZD1T             XD0F             YD0F             ZD0F

 10.0000500E-01  0.              -25.7354054E-01  0.               0.               65.6072493E-01-42.5714092E+00  0.
 28.9739669E+01  0.                0.             12.9788761E-02 86.7833496E-01  0.               0.              -20.6752775E-03
 20.0000000E-01  0.              -10.0148153E-01  0.               0.              -10.3166621E+00-56.4940768E+00  0.
 28.9408387E+01  0.                0.             18.2930499E-02 74.3193889E-01  0.               0.              -41.5913206E-04
 30.0000000E-01  0.              -88.8891344E-02  0.               0.              -23.2123723E+00-54.2914674E+00  0.
```

```
                                    GENERALIZED COMPUTER PROGRAM
                     INDSOF  2      CASE LROLL        STAGE  1      PAGE     179
28.9646371E+01  0.           0.           -25.5797450E-02 49.4670263E-02  0.                        0.                14.1789583E-03
40.0000000E-01  0.         -38.3515171E-02  0.              0.            37.0534446E+00 17.7002194E+00  0.
28.9741095E+01  0.           0.            15.6479493E-02-41.4743296E-01  0.                        0.               -28.9934957E-03
                                                  LANDING ROLL
                              ISS =  1          ILR = 1          ICS = 0          IBS = 1
   AUTS
   YI             TR
17.1000000E-02 19.9200000E-01
                                                 PITCH AUTOPILOT
   DELQN          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELQDE
30.2934646E-01 21.0562187E-02-98.2066649E-01  0.             21.0562187E-02 80.0000000E-01
INTEG RTN.      HT =  2.0000000E-03
INTEG RTN.      HT =  2.0000000E-03
                                  TIRE DEFLECTION EXCEEDED          DELTA(1) =   1.9917309E-01
INTEG RTN.      HT =  2.0000000E-03
   2SDF
21.8550000E-01 21.8550000E-01 63.8091144E+01  0.                             69.5482273E-01 28.9704782E+01  0.                15.7244624E-02
 0.            -15.9786089E-02  0.              25.9498350E-02 28.9704825E+01 99.7258250E+00 28.9704710E+01  0.
25.9279863E-02 31.0987357E-03  0.             -91.6885901E-01  0.            -51.2784711E-03  0.               -20.1798159E-03
 0.             0.            -17.8629017E-01  0.             -32.1500550E+00 12.4671000E+04  0.                0.
 0.             0.
   LGEAR
   DELTA          P              P2             FT             SR             SF             AA             FC2
19.9173088E-02 32.2147014E+04  0.             37.0899260E+03-28.1332604E+00-37.1357980E+03-92.8566483E-01-12.5131382E+02
11.8311685E-02 22.7069475E+04  0.             56.1221120E+03 85.3309320E-01-55.5317656E+03 21.7072075E+00 51.0746493E+02
11.8311685E-02 22.7069475E+04  0.             56.1221120E+03 85.3309320E-01-55.5317656E+03 21.7072075E+00 51.0746493E+02
   HJVP           VGPT           FTRX           FTRY           FTRZ           HA             HB             DDELTA
84.4133220E-03 50.7765570E-02-30.3097823E+02  0.            -37.0907803E+03-26.5739777E+02  0.             19.9173088E-02
12.8009843E-03 77.0037582E-03 71.8415799E+01  0.            -56.1219185E+03 72.7710869E+01  0.             11.8311685E-02
12.8009843E-03 77.0037582E-03 71.8415799E+01  0.            -56.1213185E+03 72.7710869E+01  0.             11.8311685E-02
   SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET
-69.5923240E+00 30.2461592E-01 13.0365590E-01  0.             0.             0.            -11.0724907E+02-33.9583056E+01
-19.3369811E-01-34.7482160E-02 14.5065644E-01  0.             0.             0.             93.2962678E+00-28.5095365E+01
-19.3369811E-01-34.7482160E-02 14.5065644E-01  0.             0.             0.             93.2962678E+00-28.5095365E+01
   FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM
```


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OF POOR QUALITY

```
-17.4674282E+02  0.          -14.9334012E+04  0.            97.0617950E+04  0.            -17.4674282E+02  0.
      FZM          LM            MM             NM
-15.0122082E+04  0.           98.0392063E+04  0.
      VPGS
 38.7489900E+02
      TFFS
  0.              0.
                                                            T(I)
                   0.               0.
      SAC1
 32.4895541E-03 32.3621948E-03-16.0768728E-02  0.            0.            82.2484753E-04  0.
      FLEX
     POINT         XD2F          XD2T           YD2F          YD2T          ZD2F           ZD2T          XD1F
     XD1T          YD1F          YD1T           ZD1F          ZD1T          XD0F           YD0F          ZD0F
 10.0000000E-01  0.           -29.1627203E-01  0.            0.           -95.6925151E-01-69.2378808E+00  0.
 28.9707572E+01  0.            0.            91.9126745E-03 70.6670244E-01  0.            0.           -17.4586666E-03
 20.0000000E-01  0.           -14.3912825E-01  0.            0.           -52.7841694E-01-60.1049461E+00  0.
 28.9398944E+01  0.            0.           -26.2787581E-03 57.3678918E-01  0.            0.           -26.2121492E-04
 30.0000000E-01  0.           -12.2979945E-01  0.            0.            79.1251949E-01-22.4197001E+00  0.
 28.9622624E+01  0.            0.           -47.6853089E-02-77.3188444E-02  0.            0.            45.9283742E-04
 40.0000000E-01  0.           -12.2059032E-01  0.            0.            80.7427623E-01-32.2189691E-01  0.
 28.9700540E+01  0.            0.            77.8186613E-02-42.3098033E-01  0.            0.           -17.2630082E-03
                                                          LANDING ROLL
                              ISS =  1            ILR = 1           ICS = 0            IBS = 1
      AUTS
      TI           TR
 17.1000000E-02 20.1450000E-01
                                                          PITCH AUTOPILOT
      DELQN        ALPHAE        ALPHD1         ALPDD1        ALPHET        DELQDE
 30.2904640E-01 21.0562187E-02-91.6885901E-01  0.            21.0562187E-02 80.0000000E-01
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 181

STOP

APPENDIX I

AIRPLANE B FLEXIBLE BODY EXAMPLE 6

```
STCASE TAB
ATAB01       2
ATAB02       2
ATAB80       2
ATAB10       2
ATAB11       2
ATAB12       2
ATAB15       2
ATAB16       2
ATAB51       2
ATAB52       2
ATAB53       2
ATAB56       2
ATAB57       2
CTAB.1       13
CTAB.2       13
FTAB02       5
FTAB03       20
TTAB10       50
VTAB.1       5
VTAB02       5
VTAB03       5
VTAB04       5
VTAB06       5
       TRA
REM    BCD 3SDF2-PLANPLANE
NCASE  BCD 1LROLL
REM    BCD 4INTEGRATION INFORMATION
IVARBH       0
TMAX         40.
AMINER       .00005
PRTMIN       .0
AMAXER       .001
DELTS        .001
PRINT        .05
REM    BCD 3REQ0 FOR SDF-2
AMASS        3874.899
HGC7F        10.0
GAM7D        -1.1606
VG77F        296.22076
THTBD        10.3594
RWHGR        .0
INDAPC       1
INDADD       1
INDFPA       1
INDPLA       1
INDACM       2
INDGRT       1
INDWGT       1
REM    BCD 5VEHICLE PHYSICAL PROP. DATA
INDVPC       1
XCGRF        .0
VTAB.1       2,0.,0.,5000.,1.
VTAB.2       2,0.,1.59702E+6,5000.,1.59702E+6
VTAB03       2,0.,1.59702E+6,5000.,1.59702E+6
VTAB04       2,0.,1.59702E+6,5000.,1.59702E+6
INDXZS       1
VTAB06       2,0.,1.0E+5,5000.,1.0E+5
REM    BCD 4AERODYNAMIC INPUT DATA
INDAER       1
AREFF        1605.
D1RFF        37.7
D2RFF        56.7
INDA01       1
ATAB01       -7.9573427E-3,-5.5941985E-3
```

```
ATAB.2     1.4.2.979E-3,8.8931664E-4
INDA.2     1
INDA8.     1
ATABA.     4.18951E-2,2.[illegible]844E-2
INDA10     1
ATAB10     -3.978321E-2,-3.965[illegible]349E-2
INDA11     1
ATAB11     5.7452446E-2,3.7645680E-2
INDA12     1
ATAB12     1.472.279E-3,1.2354312E-3
INDA15     1
ATAB15     -1.725E-2,-1.45E-2
INDA16     1
ATAB16     1.25E-4,5.0E-5
INDA51     1
ATAB51     7.3916484E-3,1.7[illegible]27972E-3
INDA52     1
ATAB52     -5.2147852E-4,1.[illegible]238928E-3
INDA53     1
ATAB53     -3.1368631E-4,1.8[illegible]65268E-5
INDA56     1
ATAB56     8.7E-3,7.3418182E-3
INDA57     1
ATAB57     2.0E-5,3.6363636E-5
REM    BCD 3ENGINE THRUST DATA
INDTFF     3
INDTSO     1
IT10X      4
TTAB10     -2.,-1.5,-1.,-.5,0.,.5,1.,1.5,2.          10
TTAB10     0.,.1,.2,.3                               14
TTAB10     [illegible],0.                            19
TTAB10     [illegible]                               23
TTAB10     [illegible],0.                            28
TTAB10     [illegible]                               32
TTAB10     [illegible],0.                            37
TTAB10     [illegible]                               41
TTAB10     [illegible],0.                            46
IT10W      9
REM    BCD 3LANDING GEAR DATA
NSTRUT     3
MASS       4.94[illegible],27.19587,27.19587
RX         35.[illegible]833,-2.83867,-2.83867
RY         0.,-8.3333,+8.3333
RZ         1.91567,.509583,.509583
THETAO     [illegible]
ERDEG      0.
RGR        4.47
NTIRES     2.,3.,3.
RZERO      1.[illegible]479[illegible]67,1.13125,1.13125
W          .554167,.604167,.604167
DELTAM     .198333,.1958333,.19583333
RLT        1.5E+3
IFD        1
AI         1.32.4533E+5,3.8129286E+5,3.8129286E+5
BI         1.2112257,1.412391,1.412391
FTAB02     2,[illegible],1.5E+4,[illegible]
FTAB03     6,[illegible].327,.336,.1,.330,.4,.336,1.,.336,100.,.336
MOMENT     1.2,2.6,2.6
MB         [illegible]
RF         5.48333,6.8792,6.8792
VZ         0.
PZERO      35280.,40320.,40320.
VZERO      0.1614583,.4716435,.4716435
A          .1104166,.2673611,.2673611
```

```
IL                1
INDCL1            1
NSMAIN            2
CTAB.1            0.,1.6667,1.,2.,3.
CTAB.1            136.781,136.781,443.92,443.92,443.92,443.92,443.92                    6
CTAB.1            443.92                                                               13
INDC.2            1
CTAB.2            0.,1.6667,1.,2.,3.
CTAB.2            136.781,136.781,4.23E+4,4.23E+4,4.23E+4,4.23E+4                       6
CTAB.2            4.23E+4,4.23E+4                                                      12
MUS               .1,.1,.1
ES                .03.1333,.03.16667,.0..16667
SB                1.333,1.6667,1.6667
REM        BCD    4FLEXIBLE AIRFRAME DATA
INDFLX            1
NMODE             4
GMASS1            66.5617,79.4557,7..8341,19.1131
GFREQ             13.188,16.512,3..59,43.398
SZMOD             .08,-.10,-.10,-.02,-.0042,-.0042
SZMOD             -.153,.1393,.1393,-.165,.0112,.0112                           7
ARMODE            0.,0.,-.114,.0.,-4.239E-4,0.
ARMODE            0.,0.,-.414,0.,3.543E-4,0.                                    7
ARMODE            0.,0.,.0435,0.,-6.032E-4,0.                                  13
ARMODE            0.,0.,.0544,0.,-3.134E-5,0.                                  19
PF                0.,0.,0.944,0.,0.,0.
PF                0.,0.,-0.259,0.,0.,0.                                         7
PF                0.,0.,2.915,0.,0.,0.                                         13
PF                0.,0.,0.274,0.,0.,0.                                         19
NPTS              4
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,.1973,-.0385,.0335,.0035
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,.0810,-.0200,-.153,-.165             13
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,-.100,-.0042,.1393,.0112             25
OUTMOD            0.,0.,0.,0.,0.,0.,0.,0.,.2330,-.2440,-.1072,-.125            37
ROIS              42.6667,0.,0.,35.2833,0.,1.91667
ROIS              -2.83867,8.3333,.509583,-32.3333,0.,0.                        7
REM        BCD    3PLOT TAPE DATA
IPLT              0
REM        BCD    3AUTOPILOT DATA
REM        BCD    3A. ENGINE DATA
INDAUT            1
IN                2
ZN                -.55,-.55
YN                -14.1667,14.1667
N                 0.,0.
REM        BCD    3B. DRAG CHUTE DATA
ICS               0
CDCH              .244
SSH               1605.
XCH               -9.625
YCH               0.
ZCH               -2.41667
REM        BCD    5C. PHASE BEGIN-TERMINATE
ITO               9
HF                12.25
NF                0
XRF               0.
HRF               8.796
DELTAH            3.
NLRI              0
TI                0.
KP                0
VS                10..
XS                300..
TS                12.
HS                0.
```

```
REM      BCD 4G. HOLD MANEUVER DATA
ALPDES       11.5
TTD          0.
KE       INT 1,1
PM           11.5
REM      BCD 5H. LANDING ROLL MANEUVER DATA
TSP          0.
TRV          0.
TCH          7.
TBK          0.
ISS          0.
ILR          0
IBS          0
REM      BCD 5I. ENGINE FAILURE STAGE DATA
IC       INT 0,0
XRF1         0.
IT1      INT 0,0
XRF2         0.
IT2      INT 0,0
H1           0.
IH1      INT 0,0
H2           0.
IH2      INT 0,0
HR1          0.
IHR1     INT 0,0
HR2          0.
IHR2     INT 0,0
TR1          0.
ITR1     INT 0,0
TR2          0.
ITR2     INT 0
REM      BCD 5J. BRAKE COND.STAGE DATA
IB       INT 0,0,0
TBK1         1.
IBK1     INT 0,0,0
TBK2         1.
IBK2     INT 0,0,0
REM      BCD 4K. PITCH AUTOPILOT DATA
TST          .2
ALPDL        2.
RFALPH       0.
DELALA       .01
PSH          0.
PSH2         0.
RFALP2       0.
DELQF        8.
DELQTO       0.
DELQL        -10.
DELQU        +25.
DELFD1       5.25
REM      BCD 4L. YAW AUTOPILOT DATA
RFB          .5
DELOA        .05
PSR          10.
DPSIA        .05
RFPSI        .5
PSPSI        0.
DELRL        -20.
DELRU        +20.
REM      BCD 4M. ROLL AUTOPILOT DATA
RFPHI        .5
DPHIA        .05
PSA          -10.
DELPL        -12.
DELPU        +12.
```

```
REM      BCD 5N,THROTTLE AUTOPILOT DATA
IF       INT 0,0
NDF          0.,0.
IR       INT 0,0
NB           1.,1.
NLR          0.,0.
NTO          0.,0.
K2           1.
REM      BCD 40. BRAKE AUTOPILOT DATA
MBC          0.,0.,0.
PD           .1
DELTAH       .001
OMECD1       20.

MBL          0.,0.,0.
HBU          0.,0.,0.
REM      BCD 5P. CONTROL RESPONSE DATA
DELHS        5.25
DELRPD       31.5
DELA         10.
NED1         .1
REM      BCD 40. INITIALIZATION
IAP          3
HR           10.
DELQD        4.56478
DELQDE       4.56478
DELQN        4.56478
DELPD        0.
DELRD        0.
MANLOG       1
PITCHP       1
REM      BCD 2STAGING DATA
REM      BCD 4A.GEARS INTO PROGRAM
INDLG        3
ISTAGE       0
DECRES   BCD 1HR
STESTD       11.0
         TRA
INDLG        -1
REM      BCD 4B.SMOOTH IMPACT STAGE
AINCRS   BCD 3DDELT1DDELT2DDELT3
STEST        -.05,-.05,-.05
         TRA
PRINT        .02
DELTS        .005
AMAXER       .0005
PRTMIN       0.
AINCRS   BCD 1TIMES
STEST        .9
         TRA
ATAB51       7.3516484E-3,1.7027972E-3
ATAB52       -5.2147852E-4,1.0238928E-3
ATAB53       -3.1368631E-4,1.8165268E-5
ATAB56       0.,0.
ATAB57       0.,0.
REM      BCD 5C. EFFICIENT AMAXER STAGE
AINCRS   BCD 4DELTA1DELTA2DELTA3
STEST        .1,.1,.1
         TRA
PRINT        .05
AMAXER       .01
DELTS        .01
REM      BCD 4D.SMOOTH IMPACT STAGE
AINCRS   BCD 1DDELT1
STEST        -.05
         TRA
```

```
PRINT             .02
DELTS             .005
AMAXER            .0005
REM      BCD 5E. EFFICIENT AMAXER STAGE
AINCRS   BCD 1DELTA1
STEST             .1
         TRA
PRINT             .05
AMAXER            .01
DELTS             .01
INDSTF           1
         TRA
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2   CASE LROLL   STAGE 1   PAGE 7

A.GEARS INTO PROGRAM

INITIAL PRINT OUT FOR VPCS

XCGRF	AREFF	D1RFF	D2RFF
0.	16.0500000E+02	37.7000000E+00	56.7000000E+00

PRINT CODES IDENTIFYING TIME HISTORY

ZSDF

TIME	TIMES	XG77F	YG77F	HGC7F	U777F	V777F	W777F
PI77R	QI77R	RI77R	AMACH	VA77F	DYNPP	XG77F1	YG77F1
ZG77F1	ALPHD	BETAD	ALPHD1	BETAD1	GAM7D	SIG7D	THTPD
FSIPD	PHIFD	AX77F	AY77F	AZ77F	WTR7P	FDC	FCX
FCY	FCZ						

VPCS

AMASS

TFFS

HT	HT

SAC1

CAVAH	CA	CN	CY	CL	CM	CNN

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                   INDSDF  2     CASE LROLL       STAGE  1     PAGE      8

     2SDF

 0.             0.              0.                0.             10.0000000E+00 29.0274042E+01  0.             59.0569126E+00
 0.             0.              0.           26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00   0.                0.              0.           -11.6059853E-01  0.             10.3393988E+00
 0.             0.         57.7454851E-01         0.          -31.6515539E+00 12.4671000E+04  0.              0.
 0.             0.

     VPCS

38.7489900E+02

     TFFS

 0.             0.

                                                            T(I)
                 0.              0.

     SAC1

29.7745819E-03-20.8749533E-03 60.9750569E-02 0.          0.           15.3281670E-03  0.

                                                          FLARE
    AUTS
    ALFDES          PHIDES         TTO

11.5800000E+00  0.              0.

                                                      PITCH AUTOPILOT

    DELON           ALPHAE         ALPH01          ALPD01           ALPHET          DELODE

26.8544760E-01-14.0024531E-07  0.              0.             -14.0024531E-07 26.8544760E-01

INTEG RTN.      HT =  1.00000000E-03
     2SDF

 0.             0.              0.                0.             10.0000000E+00 29.0274042E+01  0.             59.0569126E+00
 0.             0.              0.           26.5337670E-02 29.6220760E+01 10.4252977E+01 29.6159990E+01  0.
59.9992281E-01 11.4999986E+00   0.                0.              0.           -11.6059853E-01  0.             10.3393988E+00
 0.             0.         90.1422983E-02         0.          -26.3302709E+00 12.4671000E+04  0.              0.
 0.             0.

     VPCS

38.7489900E+02
```

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```
        TFFS
   0.            0.

                                                       T(I)
               0.                0.
        SAC1
29.7745819E-03-20.8749533E-03 60.9750569E-02  0.          0.          15.3281678E-03  0.
                                                      FLARE
      AUTS
      ALPDES          PHIDES          TTD
11.5000000E+00  0.              0.
                                                 PITCH AUTOPILCT
      DELQN          ALPHAE          ALPHD1         ALPDD1         ALPHET          DELODE
27.5607208E-01-14.0024531E-07  0.              0.            -14.0024531E-07 27.5607208E-01

               STAGE ON--DEGR. HR
```

```
                     SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                          GENERALIZED COMPUTER PROGRAM

          INOSDF  2     CASE LROLL        STAGE  1     PAGE      10

      INDLG        -1
      REM     BCD  48.SMOOTH IMPACT STAGE
      AINCRS  BCD  300ELT100ELT200ELT3
      STEST        -.05,-.05,-.05
              TRA

   2SDF

0.             0.             0.             0.             10.0000000E+00 29.0274042E+01 0.             59.0569126E+00
0.             0.             0.             26.5337670E-02 29.6220760E+01 10.4252977E+01 29.615999 +01  0.
59.9992281E-01 11.4999986E+00 0.             0.             0.             -11.6059853E-01 0.            10.3393988E+00
0.             0.             90.1422983E-02 0.             -26.3102709E+00 12.4671000E+04 0.            0.
0.             0.

   LGEAR

   DELTA          P              P2             FT             SR             SF             AA             FC2

0.             35.2800000E+03 0.             0.             31.9713310E-01-38.9549765E+02-78.8562277E+01 0.
0.             40.3200000E+03 0.             0.             54.9315280E-01-10.7799996E+03-39.6383699E+01 0.
0.             40.3200000E+03 0.             0.             54.9315280E-01-10.7799996E+03-39.6383699E+01 0.

   MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 29.6159990E+01 0.             0.             -0.            0.             0.             -79.6895154E-01
33.6000000E-02 29.6159990E+01 0.             0.             -0.            0.             0.             -10.9046626E-01
33.6000000E-02 29.6159990E+01 0.             0.             -0.            0.             0.             -10.9046626E-01

   SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

0.             0.             0.             0.             0.             0.             0.             0.
0.             0.             0.             0.             0.             0.             0.             0.
0.             0.             0.             0.             0.             0.             0.             0.

   FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

0.             0.             0.             0.             0.             0.             0.             0.

   FZM            LM             MM             NM

0.             0.             0.             0.

     VFCS

38.7489900E+02

     TFFS

0.             0.
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
                    INDSDF  2      CASE LROLL        STAGE  1      PAGE      11

                                                      T(I)
              0.                0.
     SAC1
29.7745819E-03-20.8749533E-03 60.9758569E-02  0.           0.          15.3281670E-03  0.
     FLEX
     POINT           XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T            YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F

10.0000000E-01  0.            91.2652002E-02  0.             0.            0.            -28.9135646E+00  0.
29.0274042E+01  0.             0.             0.            59.0569128E+00  0.             0.             18.5462913E-02
20.0000000E-01  0.            10.2398815E-01  0.             0.            0.            -28.4544208E+00  0.
29.0274042E+01  0.             0.             0.            59.0569128E+00  0.             0.             10.7664860E-02
30.0000000E-01  0.            92.5024062E-02  0.             0.            0.            -26.1584011E+00  0.
29.0274042E+01  0.             0.             0.            59.0569126E+00  0.             0.            -11.9773242E-02
40.0000000E-01  0.            91.5277229E-02  0.             0.            0.            -24.3726223E+00  0.
29.0274042E+01  0.             0.             0.            59.0569126E+00  0.             0.             22.8822210E-02
                                                          FLARE
     AUTS
     ALPDES          PHIDES          TTO

11.5000000E+00  0.            0.
                                                     PITCH AUTOPILOT
     DELON           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELCDE

27.5339224E-01-14.0024531E-07  0.            0.            -14.0024531E-07 27.5339224E-01
INTEG RTN.      HT =   8.00000000E-04
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
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INTEG RTN.      HT =   1.60000000E-03
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ORIGINAL PAGE IS
OF POOR QUALITY

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INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
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INTEG RTN.      HT =  1.60000000E-03
INTEG RTN.      HT =  1.60000000E-03
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2SDF

50.0000000E-03	50.0000000E-03	14.8031858E+00	0.	96.9255346E-01	29.0027313E+01	0.	59.3321982E+00
0.	27.2691345E-04	0.	26.5170136E-02	29.6034039E+01	10.4122524E+01	29.5967121E+01	0.
62.9408593E-01	11.5617295E+00	0.	12.6599115E-01	0.	-12.1827675E-01	0.	10.3434516E+00
0.	0.	94.7837143E-02	0.	-26.7864184E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	35.2800000E+03	0.	0.	37.1612726E-01	-38.9549765E+02	-78.8562277E+01	0.
0.	40.3200000E+03	0.	0.	44.6574281E-01	-10.7799996E+03	-39.6383699E+01	0.
0.	40.3200000E+03	0.	0.	44.6574281E-01	-10.7799996E+03	-39.6383699E+01	0.
MUVP	VGPT	FTRX	FTRY	FTRZ	HA	HB	DDELTA

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
                 INDSDF  2     CASE LROLL        STAGE  1     PAGE     13

33.6000000E-02 29.5973017E+01  0.          0.          -0.         0.          0.          -75.5784194E-01
33.6000000E-02 29.5985279E+01  0.          0.          -0.         0.          0.          -90.1007321E-02
33.6000000E-02 29.5985279E+01  0.          0.          -0.         0.          0.          -90.1007321E-02
     SD2           SD1           S           S2D2        S2D1         S2          OMETD1       OMET
 0.            0.            0.          0.          0.          0.          0.          0.
 0.            0.            0.          0.          0.          0.          0.          0.
 0.            0.            0.          0.          0.          0.          0.          0.
     FTRA          FTRB          FTRC        HTX         HTY         HTZ         FXM         FYM
 0.            0.            0.          0.          0.          0.          0.          0.
     FZM           LM            MM          NM
26.4586471E+00 0.           17.8487823E+01 0.
     VPCS
30.7489900E+02
     TFFS
 0.            0.
                                                  T(I)
               0.            0.
     SAC1
30.0142517E-03-21.9773025E-03 62.1249652E-02 0.          0.          12.2575620E-03 0.
     FLEX
     POINT         XD2F          XD2T        YD2F        YD2T        ZD2F        ZD2T        XD1F
     YD1T          YD1F          YD1T        ZD1F        ZD1T        XD0F        YD0F        ZD0F

10.0000000E-01 0.           95.6591171E-02 0.           0.          51.4324665E-02-20.3400744E+00 0.
29.0027819E+01 0.            0.          13.1314487E-03 59.2269616E+00 0.          0.          10.5681969E-02
20.0000000E-01 0.           10.4579527E-01 0.           0.          55.1828791E-02-27.5350303E+00 0.
29.0032834E+01 0.            0.          16.3322030E-03 59.2528612E+00 0.          0.          10.7952610E-02
30.0000000E-01 0.           96.6655680E-02 0.           0.         -53.6546557E-02-27.1853834E+00 0.
29.0028375E+01 0.            0.         -15.2076542E-03 59.3247313E+00 0.          0.         -12.0042099E-02
40.0000000E-01 0.           95.9324761E-02 0.           0.          07.3935752E-02-24.3453439E+00 0.
29.0027938E+01 0.            0.          24.8658597E-03 59.4452341E+00 0.          0.          22.9254624E-02
                                                  FLARE
     AUTS
```

ALPDES	PHIDES	TTD
11.5000000E+00	0.	0.

PITCH AUTOPILCT

DELON	ALPHAE	ALPHD1	ALPCD1	ALPHET	DELODE
20.2700935E-01	61.7294630E-03	12.6593115E-01	0.	61.7294630E-03	20.2700935E-01

```
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
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INTEG RTN.      HT =   1.60000000E-03
INTEG RTN.      HT =   1.60000000E-03
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SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM


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INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
INTEG RTN.     HT =  1.60000000E-03
```

2SDF

```
10.0000000E-02 10.0000000E-02 29.5966769E+00  0.                93.7098797E-01 28.9775545E+02  0.              59.6185786E+00
 0.            43.2850607E-04  0.            26.5800497E-02 29.5644962E+01 10.3990553E+01 29.5772244E+01  0.
65.6446534E-01 11.6258594E+00  0.            12.9349867E-01  0.           -12.7143277E-01  0.             10.3544256E+00
 0.             0.            99.5833827E-02  0.           -27.2744307E+00 12.4671000E+04  0.              0.
 0.             0.
```

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	35.2800000E+03	0.	0.	34.9155442E-01	-38.9549765E+02	-78.8562277E+01	0.
0.	40.3200000E+03	0.	0.	39.9567089E-01	-10.7799996E+03	-39.6383699E+01	0.
0.	40.3200000E+03	0.	0.	39.9567089E-01	-10.7799996E+03	-39.6383699E+01	0.

MUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6800000E-02	29.5784944E+01	0.	0.	-0.	0.	0.	-72.4166619E-01
33.6000000E-02	29.5801332E+01	0.	0.	-0.	0.	0.	-58.0610413E-02
33.6000000E-02	29.5801332E+01	0.	0.	-0.	0.	0.	-58.0610413E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
0.	0.	0.	0.	0.	0.	0.	0.

FZM	LM	MM	NM
24.3554817E+00	0.	13.8567145E+01	0.

VPCS
38.7489900E+02

TFFS

ORIGINAL PAGE IS
OF POOR QUALITY

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 0.              0.
                                                                T(I)
              0.               0.
     SAC1

 30.2764887E-03-23.1194946E-03 63.3356138E-02  0.            0.              90.5418689E-04  0.
     FLEX  .

    POINT          XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
    XD1T           YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

 10.0000000E-01  0.              10.0200456E-01  0.              0.              86.4210360E-02-27.9360057E+00  0.
 28.9776449E+01  0.              0.              48.9324028E-03  59.4615946E+00  0.              0.              18.7159974E-02
 20.0000000E-01  0.              10.6787046E-01  0.              0.              37.0598915E-02-28.1584752E+00  0.
 28.9785328E+01  0.              0.              42.1630031E-03  59.4014417E+00  0.              0.              10.9455988E-02
 30.0000000E-01  0.              10.0935864E-01  0.              0.             -40.1419188E-02-27.6543493E+00  0.
 28.9777419E+01  0.              0.             -43.3613657E-03  59.5890238E+00  0.              0.             -12.1519492E-02
 40.0000000E-01  0.              10.0557384E-01  0.              0.              90.9801357E-02-25.2083722E+00  0.
 28.9776664E+01  0.              0.              72.5014667E-03  59.8473816E+00  0.              0.              23.1687110E-02
                                                                FLARE
    AUTS

    ALPDES          PHIDES          TTD

 11.5000000E+00  0.              0.
                                                          PITCH AUTOPILOT
    DELON           ALPHAE          ALPHD1          ALPDD1          ALPHET          DELCDE

 29.0985706E-01 12.5858422E-02 12.9349867E-01  0.              12.5858422E-02 29.0985706E-01

INTEG RTN.        HT =   1.6000000E-03
INTEG RTN.        HT =   1.6000000E-03
INTEG RTN.        HT =   1.6000000E-03
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INTEG RTN.       HT =  1.60000000E-03
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INTEG RTN.       HT =  1.60000000E-03
INTEG RTN.       HT =  1.60000000E-03

      2SDF

15.0000000E-02 15.0000000E-02 44.3803598E+00  0.              98.3652141E-01 28.9520435E+01  0.                59.9059780E+00
 0.            62.8675928E-04  0.            26.4828396E-02 29.5653189E+01 10.3856782E+01 29.5574749E+01  0.
68.1000511E-01 11.6903561E+00  0.            12.8113987E-01  0.            -13.1985334E-01  0.                10.3705021E+00
 0.             0.            10.4422113E-01  0.            -27.7778787E+00 12.4671000E+04  0.                 0.
 0.             0.

      LGEAR

      DELTA         P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.             31.4902661E-01-38.9549765E+02-78.8562277E+01  0.
 0.            40.3200000E+03  0.             0.             37.5811505E-01-10.7799996E+03-39.6383699E+01  0.
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

                  INDSOF  2     CASE LROLL        STAGE  1      PAGE      18

 0.             60.3280000E+03  0.           0.           37.5811505E-01-10.7799996E+03-39.6363699E+01  0.
      MUVP           VGPT           FTRX          FTRY          FTRZ          MA            MB            ODELTA

33.6800000E-02 29.5590914E+01  0.           0.           -0.            0.            0.            -69.1487722E-01
33.6800000E-02 29.5612166E+01  0.           0.           -0.            0.            0.            -24.8322627E-02
33.6000000E-02 29.5612166E+01  0.           0.           -0.            0.            0.            -24.8322627E-02
      SO2            SO1          S             S2O2          S2O1          S2            OMETD1        OMET

 0.             0.            0.           0.            0.            0.            0.            0.
 0.             0.            0.           0.            0.            0.            0.            0.
 0.             0.            0.           0.            0.            0.            0.            0.
      FTRA           FTRB          FTRC          MTX           MTY           MTZ           FXM           FYM

 0.             0.            0.           0.            0.            0.            0.            0.
      FZM            LM            MM            NM

92.4689028E-01  0.          40.7664789E+00  0.
      VPCS

38.7489900E+02
      TFFS

 0.             0.

                                                      T(I)
                 0.              0.
      SAC1

30.5566271E-03-24.2740905E-03 64.5784391E-02  0.           0.           57.8052216E-04  0.
      FLEX

      POINT          XO2F          XO2T          YO2F          YO2T          ZO2F          ZO2T          XO1F
      XO1T           YO1F          YO1T          ZO1F          ZO1T          XO0F          YO0F          ZO0F

10.0000000E-01  0.          10.4805905E-01  0.            0.            86.1109423E-02-27.8883618E+00  0.
28.9521634E+01  0.           0.           93.9243789E-03 59.7316679E+00  0.            0.           19.8731982E-02
20.0000000E-01  0.          10.8968562E-01  0.            0.            77.4745869E-03-28.4993856E+00  0.
28.9533183E+01  0.           0.           52.2996503E-03 59.7377182E+00  0.            0.           11.1880385E-02
30.0000000E-01  0.          10.5236131E-01  0.            0.           -17.7023431E-02-27.8902810E+00  0.
28.9522858E+01  0.           0.          -59.5530950E-03 59.8642718E+00  0.            0.          -12.4158096E-02
40.0000000E-01  0.          10.5231357E-01  0.            0.            74.2456941E-02-26.2991382E+00  0.
28.9521921E+01  0.           0.           11.3863919E-02 60.2231144E+00  0.            0.           23.6383140E-02
```

FLARE

AUTS

ALPDES	PHIDES	TTD
11.5000000E+00	0.	0.

PITCH AUTOPILOT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELODE
29.9899793E-01	19.0356113E-02	12.8113987E-01	0.	19.0356113E-02	29.9899793E-01

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSOF 2 CASE LROLL STAGE 1 PAGE 58

LANDING ROLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
18.9500000E-02	41.8000000E-02

PITCH AUTOPILOT

DELON	ALPHAE	ALPHO1	ALPOD1	ALPHET	DELODE
30.6287623E-01	23.4068797E-02	-93.2446600E-01	0.	23.4068797E-02	41.6537623E-01

```
INTEG RTN.       HT =  1.00000000E-03
INTEG RTN.       HT =  1.00000000E-03
INTEG RTN.       HT =  1.00000000E-03
INTEG RTN.       HT =  1.00000000E-03
```

2SDF

61.9500000E-02	61.9500000E-02	18.2354785E+01	0.	71.5142415E-01	28.8715473E+01	0.	47.9608093E+00
0.	-57.4163149E-03	0.	26.2156271E-02	29.2671939E+01	10.1778455E+01	29.2660206E+01	0.
-14.7805606E-01	94.3172749E-01	0.	-84.3673478E-01	0.	28.9358045E-02	0.	97.2108469E-01
0.	0.	76.1005372E-01	0.	-58.0025239E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	35.2800000E+03	0.	0.	-22.7121332E+00	-38.9549765E+02	-78.8562277E+01	0.
14.4163498E-02	30.0659730E+04	0.	72.8463829E+03	-26.9263388E+00	-71.5387212E+03	48.0830984E+00	74.3252619E+02
14.4163498E-02	30.0659730E+04	0.	72.8463829E+03	-26.9263388E+00	-71.5387212E+03	48.0830984E+00	74.3252619E+02

MUVP	VGPT	FTRX	FTRY	FTRZ	MA	MB	DDELTA
33.6000000E-02	29.2507029E+01	0.	0.	-0.	0.	0.	-46.5120153E-01
22.3454122E-03	13.6150710E-02	16.5784190E+02	0.	-74.1916006E+03	16.3643336E+02	0.	14.4163498E-02
22.3454122E-03	13.6150710E-02	15.5784190E+02	0.	-74.1916006E+03	16.3643336E+02	0.	14.4163498E-02

SD2	SD1	S	S2D2	S2D1	S2	OMETD1	OMET
0.	0.	0.	0.	0.	0.	0.	0.
-10.5552668E+00	-41.9177575E-02	15.2750648E-01	0.	0.	0.	20.9799148E+01	-29.6428320E+01
-10.5552668E+00	-41.9177575E-02	15.2750648E-01	0.	0.	0.	20.9799148E+01	-29.6428320E+01

FTRA	FTRB	FTRC	MTX	MTY	MTZ	FXM	FYM
28.3228910E+03	0.	-14.5692766E+04	0.	-24.6938903E+04	0.	28.3228910E+03	0.

```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM

                    INDSDF  2      CASE LROLL        STAGE  1       PAGE       59

     FZM              LM             MM               NM

-14.6248357E+04  0.             -24.8450452E+04  0.

      VPCS

 38.7489900E+02

      TFFS

  0.           0.

                                                                      T(I)
               0.                0.

      SAC1

 32.3008941E-03-71.3372381E-04 48.0572603E-02  0.              0.              16.4362625E-03  0.

      FLEX

      POINT            X02F            X02T            Y02F            Y02T            Z02F            Z02T            X01F
      XD1T             Y01F            YD1T            Z01F            ZD1T            XD0F            YD0F            ZD0F

 10.0000000E-01  0.             75.0560723E-01  0.              0.             -12.2771290E-01-55.2968182E+00  0.
 28.8706569E+01  0.              0.            -43.4240241E-02 49.9763338E+00  0.              0.              14.8119648E-02
 20.0000000E-01  0.             73.6289264E-01  0.              0.              35.0469081E-02-54.4240641E+00  0.
 28.8600622E+01  0.              0.            -46.0705511E-02 49.5144576E+00  0.              0.              83.6497008E-03
 30.0000000E-01  0.             75.2719122E-01  0.              0.             -37.2775762E-02-58.6386750E+00  0.
 28.8691540E+01  0.              0.             46.8997422E-02 48.2668208E+00  0.              0.             -93.4361560E-03
 40.0000000E-01  0.             77.7685962E-01  0.              0.             -11.8580239E-01-62.1731148E+00  0.
 28.8705045E+01  0.              0.            -67.0176070E-02 45.4341743E+00  0.              0.              18.1617486E-02
                                                                LANDING RCLL
                                ISS =  1           ILR = 1           ICS = 0          IBS = 1
     AUTS

      TI               TR

 18.9500000E-02 43.0000000E-02

                                                             PITCH AUTOPILCT

     DELON            ALPHAE          ALPHO1          ALPDD1          ALPHET          DELODE

 38.6287623E-01 23.4068797E-02-84.3673478E-01  0.              23.4068797E-02 42.7037623E-01

INTEG RTN.       HT =   1.00000000E-03
INTEG RTN.       HT =   1.00000000E-03
INTEG RTN.       HT =   1.00000000E-03
INTEG RTN.       HT =   1.00000000E-03
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                    INDSOF  2      CASE LROLL        STAGE  1      PAGE     60

      2SOF

 63.9500000E-02 63.9500000E-02 18.8207719E+01  0.             71.8580541E-01 28.8806971E+01  0.             47.1654653E+00
  0.           -58.8548507E-03  0.            26.2121385E-02 29.2632957E+01 18.1751242E+01 29.2626548E+01  0.
-19.3679560E-01 92.7517313E-01  0.           -71.5439120E-01  0.            37.9216068E-02  0.             96.5438886E-01
  0.             0.            67.6663454E-01  0.           -51.0686601E+00 12.4671000E+04  0.              0.
  0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

  0.            35.2800000E+03  0.             0.           -12.5647480E+00-38.9549765E+02-78.8562277E+01  0.
 12.6841829E-02 28.7971062E+04  0.            60.6639297E+03-23.8480199E+00-59.4149857E+03 45.9240317E+00 16.3155628E+03
 12.6841829E-02 28.7971062E+04  0.            60.6639297E+03-23.8480199E+00-59.4149857E+03 45.9240317E+00 16.3155628E+03

     MUVP           VGPT           FTRX           FTRY           FTRZ           HA             HB             DOELTA

 33.6000000E-02 29.2470964E+01  0.             0.            -0.             0.             0.            -46.5256174E-01
 36.5758033E-03 22.2836144E-02 22.6479980E+02  0.           -61.9207126E+03 22.7478343E+02  0.             12.6841829E-02
 36.5758033E-03 22.2836144E-02 22.6479980E+02  0.           -61.9207126E+03 22.7478343E+02  0.             12.6841829E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETO1         OMET

  0.             0.             0.             0.             0.             0.             0.             0.
-96.4231701E-01-62.1056120E-02 15.1707475E-01  0.             0.             0.            29.1638901E+01-29.1375858E+01
-96.4231701E-01-62.1056120E-02 15.1707475E-01  0.             0.             0.            29.1638901E+01-29.1375858E+01

     FTRA           FTRB           FTPC           HTX            HTY            HTZ            FXM            FYM

 25.2342301E+03  0.           -12.1327859E+04  0.           -19.3822051E+04  0.            25.2342301E+03  0.

     FZM            LM             MM             NM

-12.1640261E+04  0.           -19.3778949E+04  0.

      VPCS

 38.7485900E+02

      TFFS

  0.             0.

                                                        T(I)
                 0.             0.

      SAC1

 32.2692174E-03-60.3650629E-04 46.6857194E-02  0.             0.             18.1059538E-03  0.
```

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

FLEX

POINT / X01T	X02F / Y01F	X02T / Y01T	Y02F / Z01F	Y02T / Z01T	Z02F / X00F	Z02T / Y00F	X01F / Z00F
10.0000000E-01	0.	66.6487637E-01	0.	0.	-49.2169613E-02	-49.3619608E+00	0.
28.8798776E+01	0.	0.	-45.2045461E-02	49.2245621E+00	0.	0.	13.9231086E-02
20.0000000E-01	0.	65.9032029E-01	0.	0.	49.6357584E-01	-44.3036722E+00	0.
28.8689762E+01	0.	0.	-40.6457985E-02	48.8238297E+00	0.	0.	74.8230520E-03
30.0000000E-01	0.	67.0503001E-01	0.	0.	-43.4929999E-01	-55.5660188E+00	0.
28.8781947E+01	0.	0.	42.0742187E-02	47.4191380E+00	0.	0.	-84.4052197E-03
40.0000000E-01	0.	69.4647305E-01	0.	0.	31.9664664E-01	-49.5383407E+00	0.
28.8797069E+01	0.	0.	-64.9999634E-02	44.6124942E+00	0.	0.	16.8268183E-02

LANDING RCLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
18.9500000E-02	45.0000000E-02

PITCH AUTOPILCT

DELON	ALPHAE	ALPHD1	ALPCD1	ALPHET	DELODE
30.6287623E-01	23.4068797E-02	-71.5439120E-01	0.	23.4068797E-02	43.7537623E-01

INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03
INTEG RTN. HT = 1.00000000E-03

2SDF

65.9500000E-02	65.9500000E-02	19.4059891E+01	0.	72.2785761E-01	28.8878639E+01	0.	46.5181050E+00
0.	-59.4341048E-03	0.	26.2091966E-02	29.2600072E+01	10.1728249E+01	29.2591494E+01	0.
-22.4047323E-01	31.4790497E-01	0.	-55.4879583E-01	0.	43.8724858E-02	0.	95.8652978E-01
0.	0.	55.6082684E-01	0.	-42.7855583E+00	12.4671000E+04	0.	0.
0.	0.						

LGEAR

DELTA	P	P2	FT	SR	SF	AA	FC2
0.	35.2800000E+03	0.	0.	-28.7261411E-01	-38.9549765E+02	-78.8562277E+01	0.
10.3936698E-02	27.2238325E+04	0.	45.6512758E+03	-18.0207715E+00	-44.5268494E+03	41.3454840E+00	27.2235437E+03
10.3936698E-02	27.2238325E+04	0.	45.6512758E+03	-18.0207715E+00	-44.5268494E+03	41.3454840E+00	27.2235437E+03

HUVP	VGPT	FTRX	FTRY	FTRZ	MA	MO	DDELTA

C-5

```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM
                     INDSDF  2      CASE LROLL        STAGE  1     PAGE     62

33.6000000E-02 29.2455480E+01  0.                0.              -0.               0.               0.                -46.5897470E-01
55.8046077E-03 33.9951627E-02 26.0821420E+02     0.              -46.7383305E+03 26.7945314E+02     0.                 10.3936698E-02
55.8046077E-03 33.9951627E-02 26.0821420E+02     0.              -46.7383305E+03 26.7945314E+02     0.                 10.3936698E-02
      SD2            SD1            S              S2D2             S2D1             S2              OMETD1            OMET
  0.              0.             0.              0.               0.               0.               0.              0.
-83.9998454E-01-80.2235996E-02 15.0280086E-01    0.               0.               0.              34.3519633E+01-28.4964006E+01
-83.9998454E-01-80.2235996E-02 15.0280086E-01    0.               0.               0.              34.3519633E+01-28.4964006E+01
      FTRA           FTRB           FTRC           HTX              HTY              HTZ              FXH              FYH
 20.7108987E+03  0.            -91.3025517E+03  0.               -13.3510929E+04   0.               20.7108987E+03  0.
      FZH            LH             MH             NH
-91.4210290E+03  0.            -13.2360062E+04  0.
       VPCS
 38.7489900E+02
       TFFS
  0.              0.

                                                             T(I)
                0.              0.
       SAG1
 32.2293161E-03-51.2492268E-04 45.5342832E-02  0.               0.               19.6462698E-03  0.
       FLEX
      POINT          XD2F           XD2T           YD2F             YD2T             ZD2F             ZD2T             XD1F
      XD1T           YD1F           YD1T           ZD1F             ZD1T             XD0F             YD0F             ZD0F

 10.0000000E-01  0.            54.6301552E-01  0.               0.               46.5908203E-02-42.0093093E+00    0.
 28.8870903E+01  0.             0.            -45.2909000E-02  48.6010531E+00     0.               0.               13.8149398E-02
 20.0000000E-01  0.            54.5525513E-01  0.               0.               79.3735706E-01-34.5989009E+00    0.
 28.3760868E+01  0.             0.            -27.3913030E-02  48.3293365E+00     0.               0.               67.9193273E-03
 30.0000000E-01  0.            55.3150664E-01  0.               0.              -69.4149450E-01-49.7441676E+00    0.
 28.8852932E+01  0.             0.             30.4978460E-02  46.6543697E+00     0.               0.              -77.0609042E-03
 40.0000000E-01  0.            57.3941032E-01  0.               0.               64.5919885E-01-36.5527501E+00    0.
 28.8869358E+01  0.             0.            -55.0920948E-02  44.0454833E+00     0.               0.               15.6149183E-02
                                                            LANDING ROLL
                             ISS =  1          ILR = 1           ICS = 0          IBS = 1
      AUTS
```

```
                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM

                   INDSOF  2      CASE LROLL        STAGE  1      PAGE      63

     TI              TR

 10.9500000E-02 47.0000000E-02

                                                  PITCH AUTOPILOT

     DELON           ALPHAE          ALFHD1          ALPDD1          ALPHET          DELODE

 30.6247623E-01 23.4068797E-02-55.4879583E-01  0.                  23.4068797E-02 44.0037623E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

       250F

 67.9500000E-02 67.9500000E-02 19.9911401E+01  0.                 72.7426981E-01 28.8924035E+01  0.                 46.0403188E+00
  0.            -59.1354466E-03  0.            26.2864466E-02 29.2569324E+01 10.1706731E+01 29.2559709E+01  0.
-23.7185012E-01 90.5401354E-01  0.           -38.3742142E-01  0.             46.4500926E-02  0.                 95.1851366E-01
  0.              0.            41.5011413E-01  0.           -34.2416663E+00 12.4671000E+04  0.                  0.
  0.              0.

     LGEAR

     DELTA           P               P2              FT              SR              SF              AA              FC2

  0.            35.2800000E+03  0.              0.            44.8110571E-01-38.9549765E+02-78.8562277E+01  0.
 77.3022365E-03 25.5042306E+04  0.            29.9077142E+03-97.8952900E-01-28.9593522E+03 34.8715447E+00 38.4609593E+03
 77.3022365E-03 25.5042306E+04  0.            29.9077142E+03-97.8952900E-01-28.9593522E+03 34.8715447E+00 38.4609593E+03

     MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 33.6000000E-02 29.2449656E+01  0.              0.             -0.              0.              0.             -46.6661967E-01
 85.4617159E-03 52.0561062E-02 26.2932340E+02  0.            -30.7660965E+03 27.7116952E+02  0.              77.3022365E-03
 85.4617159E-03 52.0561062E-02 26.2932340E+02  0.            -30.7660965E+03 27.7116952E+02  0.              77.3022365E-03

     SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET

  0.              0.              0.              0.              0.              0.              0.              0.
-66.4901969E-01-95.3542100E-02 14.8518505E-01  0.              0.              0.            35.5278143E+01-27.7903985E+01
-66.4901969E-01-95.3542100E-02 14.8518505E-01  0.              0.              0.            35.5278143E+01-27.7903985E+01

     FTRA            FTRB            FTRC            MTX             MTY             MTZ             FXM             FYM

 15.3615974E+03  0.            -59.8154284E+03  0.            -74.6776193E+03  0.            15.3615974E+03  0.

     FZM             LM              MM              NM

-59.5165043E+03  0.            -73.1378558E+03  0.
```

```
                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                GENERALIZED COMPUTER PROGRAM
                 INDSOF  2      CASE LROLL        STAGE  1     PAGE     64

   VPCS
38.7489980E+02
   TFFS
 0.          0.
                                                  T(I)
             0.               0.
   SAC1
32.1844233E-03-44.0877100E-04 44.6352003E-02  0.              0.              21.0374867E-03  0.
   FLEX
  POINT          XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
  XD1T           YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F
10.0000000E-01  0.             48.5635029E-01  0.              0.              16.1407074E-01-34.1325170E+00  0.
28.8916865E+01  0.              0.            -43.2606656E-02 48.1308265E+00  0.              0.              12.1255697E-02
20.0000000E-01  0.             41.1003538E-01  0.              0.              82.3333095E-01-27.2524810E+00  0.
28.8806902E+01  0.              0.            -10.7744051E-02 48.0072413E+00  0.              0.              64.0925964E-03
30.0000000E-01  0.             41.5674268E-01  0.              0.             -73.7496943E-01-41.5182934E+00  0.
28.8898183E+01  0.              0.             15.0263162E-02 46.0307159E+00  0.              0.             -72.4137631E-03
40.0000000E-01  0.             43.1654775E-01  0.              0.              75.2851995E-01-25.5727002E+00  0.
28.8915370E+01  0.              0.            -40.7502886E-02 43.7707718E+00  0.              0.              14.6523530E-02
                                                    LANDING ROLL
                     ISS =  1          ILR = 1            ICS = 0          IBS = 1
  AUTS
  TI              TR
18.9500000E-02 49.0000000E-02
                                                  PITCH AUTOPILOT
  DELON           ALPHAE          ALPHO1          ALPDD1          ALPHET          DELODE
38.6287623E-01 23.4068797E-02-38.3742142E-01  0.              23.4068797E-02 45.8537623E-01
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
   2SDF
```

```
                                     SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM
                               INDSDF  2      CASE LROLL          STAGE  1       PAGE      65

 69.9500000E-02 69.9500000E-02 20.5762277E+01  0.                73.2162278E-01 28.8940484E+01  0.                45.7297821E+00
  0.            -58.0556228E-03  0.             26.2035421E-02 29.2536851E+01 10.1664014E+01 29.2527510E+01  0.
-23.3775828E-01 59.9342769E-01  0.            -22.6879500E-01  0.             45.7874529E-02  0.                94.5130197E-01
  0.              0.             27.3446602E-01  0.             -26.6753115E+00 12.4671000E+04  0.                0.
  0.              0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

  0.            35.2800000E+03  0.              0.             84.5784705E-01-38.9549765E+02-78.8562277E+01  0.
 49.5319335E-03 23.7767555E+04  0.             15.8041840E+03-38.0027115E-02-15.0525910E+03 27.6362912E+00 48.0190304E+03
 49.5319335E-03 23.7767555E+04  0.             15.8041840E+03-38.0027115E-02-15.0525910E+03 27.6362912E+00 48.0190304E+03

     MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 33.6000000E-02 29.2440577E+01  0.              0.             -0.             0.              0.            -46.7255999E-01
 14.1331083E-02 86.0777998E-02 23.1891768E+02  0.            -16.4076977E+03 25.0841515E+02  0.             49.5319335E-03
 14.1331083E-02 86.0777998E-02 23.1891768E+02  0.            -16.4076977E+03 25.0841515E+02  0.             49.5319335E-03

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

  0.              0.             0.              0.             0.             0.             0.             0.
-44.8099076E-01-10.6545843E-01 14.6492302E-01  0.             0.             0.             32.1591686E+01-27.1055037E+01
-44.3099076E-01-10.6545843E-01 14.6492302E-01  0.             0.             0.             32.1591686E+01-27.1055037E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

 99.6347103E+02  0.            -31.6033651E+03  0.            -26.3904757E+03  0.             99.6347103E+02  0.

     FZM            LM             MM             NM

-31.5743247E+03  0.            -25.1960146E+03  0.

      VPCS

 38.7489900E+02

      TFFS

  0.              0.

                                                                 T(I)
                 0.             0.

      SACI

 32.1379569E-03-38.7438832E-04 43.9855243E-02  0.              0.             22.2808682E-03  0.

      FLEX
```

```
                                        SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                            GENERALIZED COMPUTER PROGRAM

                               INDSDF  2      CASE LROLL         STAGE  1      PAGE      66

        POINT            XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
        XD1T             YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

 10.0000000E-01  0.               26.4365212E-01  0.               0.             28.5394264E-01-26.8107399E+00  0.
 28.8933923E+01  0.                0.            -38.8203020E-02 47.8185409E+00  0.              0.             11.3005968E-02
 20.0000000E-01  0.               27.5069491E-01  0.               0.             58.5737511E-01-23.2824492E+00  0.
 28.8825526E+01  0.                0.             36.6804113E-03 47.8031653E+00  0.              0.             63.4614578E-03
 30.0000000E-01  0.               27.7185595E-01  0.               0.            -56.3633393E-01-32.1144763E+00  0.
 28.3915001E+01  0.                0.             25.2491687E-03 45.5901505E+00  0.              0.            -70.6367478E-03
 40.0000000E-01  0.               28.8413366E-01  0.               0.             63.4357727E-01-18.0663557E+00  0.
 28.8932366E+01  0.                0.            -26.6059955E-02 43.5665123E+00  0.              0.             13.9832406E-02

                                                             LANDING ROLL
                                  ISS =  1            ILR = 1              ICS = 0            IBS = 1
       AUTS

       TI                TR

 18.9500000E-02 51.0000000E-02

                                                             PITCH AUTOPILOT

       DELON            ALPHAE           ALFHD1           ALPDD1           ALPHET           DELODE

 30.6287623E-01 23.4068797E-02-22.6879500E-01  0.                 23.4068797E-02 46.9037623E-01

INTEG RTN.        HT =  1.00000000E-03
INTEG RTN.        HT =  1.00000000E-03
INTEG RTN.        HT =  1.00000000E-03
INTEG RTN.        HT =  1.00000000E-03

         2SDF

 71.9500000E-02 71.9500000E-02 21.1612473E+01  0.                73.6687401E-01 28.8929026E+01  0.              45.5599224E+00
  0.           -56.3997577E-03  0.              26.2001595E-02 29.2499041E+01 10.1657596E+01 29.2491063E+01  0.
-21.6836915E-01 89.6093032E-01  0.             -10.5881588E-01  0.             42.4753271E-02  0.              93.8568226E-01
  0.              0.            14.4739581E-01  0.             -21.1149502E+00 12.4671000E+04  0.               0.
  0.              0.

       LGEAR

       DELTA            P               P2               FT               SR               SF               AA               FC2

  0.            35.2800000E+03  0.               0.              92.4161051E-01-38.9549765E+02-78.8562277E+01  0.
 23.5065123E-03 22.1446045E+04  0.              53.8731842E+02 84.2208139E-01-48.0952364E+02 21.2456808E+00 54.1445551E+03
 23.5065123E-03 22.1446045E+04  0.              53.8731842E+02 84.2208139E-01-48.0952364E+02 21.2456808E+00 54.1445551E+03

       MUVP             VGPT             FTRX             FTRY             FTRZ             HA               HB              DDELTA

 33.6000000E-02 29.2417017E+01  0.               0.              -0.               0.               0.             -46.7514655E-01
 28.0730979E-02 17.0961197E-01 16.0750057E+02  0.             -57.2612463E+02 17.8069829E+02  0.              23.5065123E-03
```

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
                INDSDF  2      CASE LROLL         STAGE  1      PAGE     67
28.8738979E-02 17.8961197E-01 16.0758057E+02  0.          -57.2612463E+02 17.8069829E+02  0.          23.5065123E-03
     SO2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET
 0.             0.             0.
-20.7552266E-01-11.3137665E-01 14.4287467E-01  0.             0.             0.             0.             0.
-20.7552266E-01-11.3137665E-01 14.4287467E-01  0.             0.             0.             22.8294653E+01-26.5425009E+01
                                              0.             0.             0.             22.8294653E+01-26.5425009E+01
     FTRA           FTRB           FTRC           HTX            HTY            HTZ            FXH            FYH
50.3958793E+02  0.            -10.7746368E+03  0.             25.8257526E+02  0.             50.3958793E+02  0.
     FZH            LH             HH             NH
-10.7625333E+03  0.             29.6276249E+02  0.
     VPCS
38.7489900E+02
     TFFS
 0.             0.
                                                              T(I)
                 0.                 0.
     SAC1
32.8930338E-03-34.8788621E-04 43.5476730E-02  0.              0.             23.3977329E-03  0.
     FLEX
     POINT          XO2F           XO2T           YO2F           YO2T           ZO2F           ZO2T           XO1F
     XO1T           YO1F           YO1T           ZO1F           ZO1T           XO0F           YO0F           ZO0F
10.0000000E-01  0.             13.5744266E-01  0.             0.             48.2825272E-01-21.0109614E+00  0.
28.8923054E+01  0.              0.            -31.9359205E-02 47.6469557E+00  0.             0.             10.5890094E-02
20.0000000E-01  0.             15.0512490E-01  0.             0.             18.4342371E-01-22.5044050E+00  0.
28.8817254E+01  0.              0.             11.4317076E-02 47.6534291E+00  0.             0.             65.1108622E-03
30.0000000E-01  0.             15.0318179E-01  0.             0.            -24.6314256E-01-23.3186274E+00  0.
28.8904294E+01  0.              0.            -56.9083326E-03 45.3429137E+00  0.             0.            -71.0595375E-03
40.0000000E-01  0.             15.8118619E-01  0.             0.             38.3877955E-01-14.3023198E+00  0.
28.8921377E+01  0.              0.            -16.3677711E-02 43.5726544E+00  0.             0.             13.5619304E-02
                                                    LANDING ROLL
                              ISS =  1         ILR = 1          ICS = 0          IBS = 1
     AUTS
     TI             TR
```

I-30

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18.9500000E-02 53.0000000E-02

                                                    PITCH AUTOPILOT
     DELON         ALPHAE         ALPHD1         ALPDD1         ALPHET         DELODE

38.6287623E-01 23.4068797E-02-18.5881588E-01  0.             23.4058797E-02 47.9537623E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

     2SDF

73.9500000E-02 73.9500000E-02 21.7461837E+01  0.             74.0776766E-01 28.8889865E+01  0.             45.4856156E+00
 0.           -54.5157802E-03  0.            26.1956639E-02 29.2448811E+01 10.1622563E+01 29.2442567E+01  0.
-19.1093306E-01 89.4774447E-01  0.           -36.2965044E-02  0.            37.4388092E-02  0.             93.2213195E-01
 0.             0.            17.2006213E-02  0.           -18.2789816E+00 12.4671000E+04  0.              0.
 0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FC2

 0.            35.2800000E+03  0.             0.            79.5363441E-01-38.9549765E+02-78.8562277E+01  0.
17.5786541E-04 20.6726346E+04  0.            13.7027887E+01 14.6862970E+00 34.7646702E+01 17.8216247E+00 55.6189763E+03
17.5786541E-04 20.6726346E+04  0.            13.7027887E+01 14.6862970E+00 34.7646702E+01 17.8216247E+00 55.6189763E+03

     HUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 29.2368394E+01  0.             0.            -0.             0.             0.            -46.7395140E-01
33.6000000E-02 49.6548940E-01 49.3812058E+00  0.           -14.6967875E+01 55.7756836E+00  0.             17.5786541E-04
33.6000000E-02 49.6548940E-01 49.3812058E+00  0.           -14.6967875E+01 55.7756836E+00  0.             17.5786541E-04

     SD2            SD1            S              S2D2           S2D1           S2             OHETD1         OHET

 0.             0.             0.             0.             0.             0.             0.             0.
75.8836669E-02-11.4659509E-01 14.2000440E-01  0.             0.             0.            71.5072867E-01-26.3162531E+01
75.8836669E-02-11.4659509E-01 14.2000440E-01  0.             0.             0.            71.5072867E-01-26.3162531E+01

     FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXH            FYH

14.5071263E+01  0.           -27.4055774E+01  0.            18.8984778E+01  0.            14.5071263E+01  0.

     FZH            LH             MH             NH

-27.3567183E+01  0.           -22.4830244E+01  0.

     VPCS
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ORIGINAL PAGE IS
OF POOR QUALITY

SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
GENERALIZED COMPUTER PROGRAM

INDSDF 2 CASE LROLL STAGE 1 PAGE 69

38.7489980E+02

TFFS

0. 0.

T(I)

0. 0.

SAC1

32.0520491E-03-31.9694618E-04 43.2573447E-02 0. 0. 24.4246761E-03 0.

FLEX

POINT XD1T	XD2F YD1F	XD2T YD1T	YD2F ZD1F	YD2T ZD1T	ZD2F XD0F	ZD2T YD0F	XD1F ZD0F
10.0000000E-01	0.	79.6239913E-03	0.	0.	49.4288288E-01	-17.3425829E+00	0.
28.8884413E+01	0.	0.	-22.9260696E-02	47.5823634E+00	0.	0.	10.0373810E-02
20.0000000E-01	0.	24.2118824E-02	0.	0.	-22.1775364E-01	-23.7968199E+00	0.
28.3781717E+01	0.	0.	10.9484098E-02	47.5076932E+00	0.	0.	67.4895687E-03
30.0000000E-01	0.	22.9240048E-02	0.	0.	95.2503512E-02	-17.0614360E+00	0.
26.8866053E+01	0.	0.	-71.0813420E-03	45.2597820E+00	0.	0.	-72.4535831E-03
40.0000000E-01	0.	29.2898734E-02	0.	0.	14.0104714E-01	-13.8417762E+00	0.
28.8882639E+01	0.	0.	-11.2959371E-02	43.6090812E+00	0.	0.	13.2934230E-02

LANDING RGLL

ISS = 1 ILR = 1 ICS = 0 IBS = 1

AUTS

TI	TR
18.9500000E-02	55.0000000E-02

PITCH AUTOPILCT

DELON	ALPHAE	ALPHD1	ALPDD1	ALPHET	DELQDE
38.6287623E-01	23.4068797E-02	-36.2965044E-02	0.	23.4068797E-02	49.8837623E-01

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                          SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                               GENERALIZED COMPUTER PROGRAM

                   INDSOF  2     CASE LROLL        STAGE  1      PAGE     171

INTEG RTN.      HT =  1.00000000E-03

      2SDF

 20.6425000E-01 20.6425000E-01 60.2928534E+01  0.                 69.8211664E-01 28.9863837E+01  0.                56.7672733E-01
 0.            -18.8595998E-02  0.             25.9690593E-02 28.9919418E+01 99.8735400E+00 28.9919355E+01  0.
 19.1827569E-02 11.2194384E-01  0.            -11.0753996E+00  0.            -37.9090005E-03  0.               10.8403361E-01
 0.              0.            -15.8768114E-01  0.               -33.5759979E+00 12.4671000E+04  0.                0.
 0.              0.

      LGEAR

      DELTA           P              P2              FT             SR             SF             AA             FD2

 84.6327626E-03 67.7873702E+03  0.             13.3485730E+03-70.4168274E-01-13.2161225E+03 26.8118420E+00-53.1400445E+02
 13.3633280E-02 24.5896209E+04  0.             66.6420522E+03 10.8773439E-01-65.8765536E+03 28.1476030E+00-45.1707663E-01
 13.3633280E-02 24.5896209E+04  0.             66.6420522E+03 10.8773439E-01-65.8765536E+03 28.1476030E+00-45.1707663E-01

      HUVP            VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

 33.6000000E-02 11.7638308E+01-44.5758270E+02  0.             -13.2668152E+03-42.9391781E+02  0.              84.6327626E-03
 42.8115357E-05 25.7579812E-04 28.5358243E+00  0.             -66.6545217E+03 28.4678155E+00  0.              13.3633280E-02
 42.8115357E-05 25.7579812E-04 28.5358243E+00  0.             -66.6545217E+03 28.4678155E+00  0.              13.3633280E-02

      SD2             SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-12.3980823E+00 62.3301353E-01 70.0890735E-02  0.              0.             0.            -17.8913242E+02-17.7539341E+01
-29.3290416E-01 10.0873334E-02 14.7481197E-01  0.              0.             0.             36.4971993E-01-28.9489227E+01
-29.3290416E-01 10.0873334E-02 14.7481197E-01  0.              0.             0.             36.4971993E-01-28.9489227E+01

      FTRA            FTRB           FTRC           HTX            HTY            HTZ            FXM            FYM

-16.2668395E+02  0.            -14.6632677E+04  0.             72.9137976E+03  0.            -16.2668395E+02  0.

      FZM             LM             MM             NM

-14.6964050E+04  0.             73.7311167E+03  0.

      VPCS

 38.7489900E+02

      TFFS

 0.              0.

                                                            T(I)
                 0.              0.

      SAC1
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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                     GENERALIZED COMPUTER PROGRAM
                       INDSOF  2      CASE LROLL         STAGE  1      PAGE    172

32.4617859E-03 28.2314695E-03-10.5182680E-02  0.               0.               70.2123958E-04   0.

    FLEX

   POINT          XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
   XD1T           YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

10.0000000E-01  0.              -28.9778415E-01  0.               0.             -75.0103141E-03-36.7544404E+00   0.
28.9869720E+01  0.                0.             -55.6094368E-02 13.1674018E+00   0.               0.             -31.1939446E-03
20.0000000E-01  0.              -25.5366099E-01  0.               0.             -30.1346752E-01-39.2094796E+00   0.
28.5505254E+01  0.                0.             -38.0662430E-02 11.9126349E+00   0.               0.             -15.3454387E-03
30.0000000E-01  0.              -16.0632484E-01  0.               0.              23.0670235E-01-31.0809453E+00   0.
28.5764358E+01  0.                0.              41.8824181E-02 55.6018971E-01   0.               0.              17.8862535E-03
40.0000000E-01  0.              -15.3067549E-02  0.               0.             -30.0229703E-01-34.2264796E+00   0.
28.5870617E+01  0.                0.             -68.1836081E-02-11.0303975E-01   0.               0.             -35.9502801E-03
                                                                 LANDING RCLL
                                   ISS =  1          ILR = 1              ICS = 0            IBS = 1
   AUTS

   TI             TR

18.9500000E-02 18.7475000E-01

                                                            PITCH AUTOPILOT

   DELON          ALPHAE          ALFHD1          ALPDD1          ALPHET          DELDDE

30.6287623E-01 23.4068797E-02-11.0753996E+00  0.              23.4068797E-02 80.0000000E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

    2SDF

20.8425000E-01 20.8425000E-01 60.8726461E+01  0.              69.7854823E-01 28.9836896E+01  0.              45.6062730E-01
 0.            -18.6971369E-02  0.              25.9646810E-02 28.9872775E+01 99.8414171E+00 28.9872720E+01   0.
16.5289200E-02 90.1483344E-02  0.             -10.9684351E+00  0.             -32.6706463E-03  0.              86.8812549E-02
 0.              0.             -18.9492869E-01  0.             -33.5019935E+00 12.4671000E+04  0.               0.
 0.              0.

   LGEAR

   DELTA          P               P2              FT              SR              SF              AA              FC2

90.1960707E-03 80.7130024E+03  0.              14.4014684E+03-46.4000902E-01-14.2788876E+03 24.8139243E+00-49.0712489E+02
13.4331966E-02 24.6947871E+04  0.              67.1405515E+03-13.8833018E-01-66.1208338E+03 37.4953144E+00-14.1072509E-01
13.4331966E-02 24.6947871E+04  0.              67.1405515E+03-13.8833028E-01-66.1208338E+03 37.4953144E+00-14.1072509E-01
```

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM
                    INDSOF  2     CASE LROLL          STAGE  1      PAGE     173
      HUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA
 33.6800000E-02 83.1762762E+00-48.1491595E+02  0.                -14.3301070E+03-46.1134434E+02  0.               90.1960707E-03
 99.0059402E-05 59.5603465E-04-66.4797792E+00  0.                -67.1472631E+03-66.2748908E+00  0.               13.4331966E-02
 99.0059402E-05 59.5603465E-04-66.4797792E+00  0.                -67.1472631E+03-66.2748908E+00  0.               13.4331966E-02
      SD2             SD1             S               S2D2            S2D1            S2              OMETD1          OMET
-11.9963858E+00 59.8963928E-01 82.3102537E-02  0.                0.              0.              -19.2139347E+02-21.4544500E+01
 39.3668316E-01 56.3727005E-03 14.7604381E-01  0.                0.              0.              -84.9678087E-01-28.9646837E+01
 39.3668316E-01 56.3727005E-03 14.7604381E-01  0.                0.              0.              -84.9678087E-01-28.9646837E+01
      FTRA            FTRD            FTRG            HTX             HTY             HTZ             FXM             FYM
-26.9370268E+02  0.             -14.0682571E+04  0.              10.0504880E+04  0.             -26.9370268E+02  0.
      FZM             LM              MM              NM
-14.8511332E+04  0.              10.3237483E+04  0.
      VPCS
 38.7489900E+02
      TFFS
  0.              0.
                                                              T(I)
                 0.              0.
      SAC1
 32.4655039E-03 29.8114487E-03-11.6661575E-02  0.                0.              73.0142175E-04  0.
      FLEX
      POINT           XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T            YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F
 10.0000000E-01  0.             -31.8627919E-01  0.              0.              94.2098128E-02-36.4964898E+00  0.
 28.9844794E+01  0.              0.             -54.5811035E-02 11.9922676E+00  0.              0.             -42.2437705E-03
 20.0000000E-01  0.             -27.9345070E-01  0.              0.             -39.9336497E-04-36.8099111E+00  0.
 28.5482899E+01  0.              0.             -40.9808535E-02 10.7103914E+00  0.              0.             -23.3463001E-03
 30.0000000E-01  0.             -19.0978103E-01  0.              0.             -30.1132952E-02-33.5590340E+00  0.
 28.9736658E+01  0.              0.              43.7369993E-02 44.6724728E-01  0.              0.              26.5309036E-03
 40.0000000E-01  0.             -50.4619520E-02  0.              0.              30.0652809E-02-30.2181456E+00  0.
 28.9846235E+01  0.              0.             -70.7596929E-02-21.9237101E-01  0.              0.             -49.9495211E-03
                                                    LANDING ROLL
                         ISS =  1           ILR = 1           IOS = 0           IDS = 1
```

```
                     SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                          GENERALIZED COMPUTER PROGRAM

            INOSOF  2      CASE LROLL        STAGE  1      PAGE     174

   AUTS

   TI              TR

10.9500000E-02 10.9475000E-01

                                                    PITCH AUTOPILOT

   DELON            ALPHAE           ALFHD1           ALPDD1           ALPHET           DELCDE

30.6287623E-01 23.4068797E-02-10.9684351E+00  0.               23.4068797E-02 80.0900000E-01

INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03
INTEG RTN.      HT =  1.00000000E-03

    2SOF

21.0425000E-01 21.0425000E-01 61.4523430E+01  0.               69.7550737E-01 28.9803104E+01  0.                34.5525434E-01
 0.           -18.4812946E-02  0.             25.9604850E-02 28.9823701E+01 99.8076236E+00 28.9823668E+01  0.
13.8392165E-02 68.3091758E-02  0.            -10.8662930E+00  0.            -27.3585315E-03  0.                65.5732755E-02
 0.             0.            -21.7719282E-01  0.             -33.6050494E+00 12.4671000E+04  0.                 0.
 0.             0.

   LGEAR

   DELTA            P                P2               FT               SR               SF               AA               FC2

98.7389096E-03 98.8670493E+03  0.              16.0505505E+03-18.9985149E-01-15.9470285E+03 20.9558630E+00-45.1153238E+02
13.4350047E-02 24.7995384E+04  0.              67.1556837E+03-48.4679888E-01-66.3807805E+03 28.4934121E+00-61.6310781E-03
13.4350047E-02 24.7995384E+04  0.              67.1556837E+03-48.4679888E-01-66.3807805E+03 28.4934121E+00-61.6310781E-03

   MUVP             VGPT             FTRX             FTRY             FTRZ             MA               MB               DDELTA

33.6000000E-02 46.7284306E+00-53.7267709E+02  0.              -15.9901104E+03-50.9962577E+02  0.                98.7389096E-03
68.6025531E-06 41.2648849E-05-46.0734947E-01  0.              -67.1600292E+03-45.9306647E-01  0.                13.4350047E-02
68.6025531E-06 41.2648849E-05-46.0734947E-01  0.              -67.1600292E+03-45.9306647E-01  0.                13.4350047E-02

   SD2              SD1              S                S2D2             S2D1             S2               OMETD1           OMET

-13.1118814E+00 57.4313668E-01 94.0466013E-02  0.                0.               0.              -21.2484407E+02-25.4864310E+01
-85.2527966E-01 11.7827734E-03 14.7726041E-01  0.                0.               0.              -58.8854675E-02-28.9620568E+01
-85.2527966E-01 11.7827734E-03 14.7726041E-01  0.                0.               0.              -58.8854675E-02-28.9620568E+01

   FTRA             FTRB             FTRC             HTX              HTY              HTZ              FXH              FYH

-36.6132276E+02  0.             -15.0361918E+04  0.               15.2459769E+04  0.              -36.6132276E+02  0.

   FZH              LH               MH               NH
```

```
-15.8786078E+04  0.             15.4689198E+04  0.
       VPCS
 38.7489900E+02
       TFFS
  0.           0.

                                                         T(I)
             0.               0.
       SAG1
 32.4686926E-03 29.8086255E-03-12.7908838E-02  0.           0.           75.6016797E-04  0.
       FLEX
      POINT         XO2F          XO2T          YO2F          YO2T          ZO2F          ZO2T          XO1F
      XO1T          YO1F          YO1T          ZO1F          ZO1T          XDOF          YDOF          ZOOF

 10.0000000E-01  0.           -34.5196111E-01  0.             0.          24.5300393E-01-36.5045958E+00  0.
 28.5812875E+01  0.             0.          -51.18.7691E-02 10.8287952E+00  0.             0.          -52.8737759E-03
 20.0000000E-01  0.           -30.0255348E-01  0.             0.          40.0442350E-01-34.0673019E+00  0.
 28.9454658E+01  0.             0.          -36.9062254E-02 95.7004011E-01  0.             0.          -31.2744970E-03
 30.0000000E-01  0.           -21.5836870E-01  0.             0.         -37.5280182E-01-37.0191445E+00  0.
 28.9702460E+01  0.             0.           39.6210272E-02 33.2684165E-01  0.             0.           34.9872614E-03
 40.0000000E-01  0.           -83.6744917E-02  0.             0.          49.0289439E-01-24.6459329E+00  0.
 28.5814893E+01  0.             0.          -65.4913425E-02-31.7527150E-01  0.             0.          -63.7351253E-03
                                                         LANDING ROLL
                               ISS =  1        ILR = 1          ICS = 0          IBS = 1
      AUTS
      TI            TR
 18.9500000E-02 19.1475000E-01
                                                         PITCH AUTOPILOT
      DELON         ALPHAE        ALFHD1        ALPDD1        ALPHET        DELODE
 30.6287623E-01 23.4068797E-02-10.8662930E+00  0.           23.4068797E-02 80.0000000E-01
INTEG RTN.      HT =  1.00000000E-03
       2SDF
 21.0675000E-01 21.0675000E-01 61.5247981E+01  0.           69.7516575E-01 28.9798256E+01  0.           33.1795692E-01
  0.           -18.4492319E-02  0.           25.9599071E-02 28.9817250E+01 99.6031812E+00 28.9817218E+01  0.
```

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                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                         GENERALIZED COMPUTER PROGRAM
                         INDSOF  2      CASE LROLL         STAGE  1      PAGE     176

13.4948912E-02 65.5961928E-02  0.             -10.8350368E+00  0.             -26.6785915E-03  0.                 62.9283035E-02
 0.             0.            -22.2610644E-01  0.             -33.5385479E+00 12.4671000E+04  0.                  0.
 0.             0.

     LGEAR

     DELTA          P              P2             FT             SR             SF             AA             FG2

10.0083082E-02 10.1656153E+04  0.             16.3131488E+03-19.2133218E-01-16.2120061E+03 20.4742237E+00-44.5922465E+02
13.4384135E-02 24.8001022E+04  0.             67.1802277E+03-48.1766433E-01-66.2333653E+03 34.8164070E+00 33.5524644E-02
13.4384135E-02 24.8001022E+04  0.             67.1802277E+03-48.1766433E-01-66.2333653E+03 34.8164070E+00 33.5524644E-02

     HUVP           VGPT           FTRX           FTRY           FTRZ           HA             HB             DDELTA

33.6000000E-02 41.9970000E+00-54.6139357E+02  0.            -16.2541475E+03-51.7649242E+02  0.             10.0083082E-02
24.7372288E-05 14.8793682E-04-16.6194838E+00  0.            -67.1840973E+03-16.5673961E+00  0.             13.4384135E-02
24.7372288E-05 14.8793682E-04-16.6194838E+00  0.            -67.1840973E+03-16.5673961E+00  0.             13.4384135E-02

     SD2            SD1            S              S2D2           S2D1           S2             OMETD1         OMET

-13.6191680E+00 57.0974600E-01 95.4782416E-02  0.             0.             0.            -21.5687184E+02-26.0216104E+01
-21.7331681E-01-28.1638504E-04 14.7726693E-01  0.             0.             0.            -21.2402515E-01-28.9624781E+01
-21.7331681E-01-28.1638504E-04 14.7726693E-01  0.             0.             0.            -21.2402515E-01-28.9624781E+01

     FTRA           FTRB           FTPC           MTX            MTY            MTZ            FXM            FYM

-38.4004004E+02  0.           -15.0673604E+04  0.             16.0406606E+04  0.            -38.4004004E+02  0.

     FZM            LM             MM             NM

-15.0672379E+04  0.             16.3730353E+04  0.

      VPCS

38.7489900E+02

      TFFS

 0.             0.

                                                              T(I)
                0.             0.

      SAC1

32.4654854E-03 29.9097614E-03-12.9297512E-02  0.             0.             75.9107567E-04  0.

      FLEX

     POINT          XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
     XD1T           YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           ZD0F
```

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                              SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                   GENERALIZED COMPUTER PROGRAM

                      INDSOF  2     CASE LROLL        STAGE  1      PAGE     177

10.0000000E-01  0.          -34.9888331E-01  0.               0.               24.1990600E-01-36.7176720E+00  0.
28.9808246E+01  0.            0.            -50.5692372E-02 10.6839430E+00  0.              0.              -54.1456083E-03
20.0000000E-01  0.          -30.4054562E-01  0.               0.               41.2149001E-01-34.0861784E+00  0.
28.9450583E+01  0.            0.            -35.8849573E-02 94.3170673E-01  0.              0.              -32.1843903E-03
30.0000000E-01  0.          -22.0057782E-01  0.               0.              -38.1980995E-01-37.0031921E+00  0.
28.9697607E+01  0.            0.             38.6691460E-02 31.8093557E-01  0.              0.               35.9658674E-03
40.0000000E-01  0.          -89.7090109E-02  0.               0.               50.2130542E-01-24.2742351E+00  0.
28.9810314E+01  0.            0.            -64.2441212E-02-32.8972980E-01  0.              0.              -65.3568100E-03
                                                     LANDING ROLL
                             ISS =  1         ILR = 1          ICS = 0          IBS = 1
   AUTS

   TI              TR

18.9500000E-02 19.1725000E-01
                                                   PITCH AUTOPILOT

   DELON          ALPHAE          ALPHO1          ALPOD1          ALPHET          DELODE

30.6287623E-01 23.4068797E-02-10.8350368E+00  0.               23.4068797E-02 80.0000000E-01

               STAGE ON--INCR. DELTA1
```

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                         SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                              GENERALIZED COMPUTER PROGRAM

                 INDSOF  2      CASE LROLL          STAGE  1      PAGE    178

            PRINT       .05
            AMAXER      .01
            DELTS       .01
            INDSTF      1
                   TRA

    2SDF

21.0675000E-01 21.0675000E-01 61.5247981E+01  0.               69.7516575E-01 28.9798256E+01  0.                33.1795692E-01
 0.           -18.4492319E-02  0.            25.9599071E-02 28.9817250E+01 99.8031812E+00 28.9817218E+01  0.
13.4946912E-02 65.5961928E-02  0.           -10.8350368E+00  0.           -26.6785915E-03  0.               62.9283035E-02
 0.             0.           -22.2610644E-01  0.           -33.5385479E+00 12.4671000E+04  0.                0.
 0.             0.

    LGEAR

    DELTA          P              P2             FT             SR             SF             AA             FC2

10.0083082E-02 10.1656153E+04  0.            16.3131485E+03-19.2133218E-01-16.2120061E+03 20.4742237E+00-44.5922465E+02
13.4384135E-02 24.8001022E+04  0.            67.1802277E+03-48.1766433E-01-66.2333653E+03 34.8164070E+00 33.5524644E-02
13.4384135E-02 24.8001022E+04  0.            67.1802277E+03-48.1766433E-01-66.2333653E+03 34.8164070E+00 33.5524644E-02

    MUVP           VGPT           FTRX           FTRY           FTRZ           MA             MB             DDELTA

33.6000000E-02 41.9970000E+00-54.6139367E+02  0.           -16.2541475E+03-51.7649242E+02  0.            10.0083082E-02
24.7372283E-05 14.8793682E-04-16.6194838E+00  0.           -67.1840973E+03-16.5673961E+00  0.            13.4384135E-02
24.7372283E-05 14.8793682E-04-16.6194838E+00  0.           -67.1840973E+03-16.5673961E+00  0.            13.4384135E-02

    SD2            SD1            S              S2D2           S2D1           S2             DMETD1         DMET

-13.6191680E+00 57.0974600E-01 95.4782416E-02  0.             0.             0.           -21.5687184E+02-26.0216104E+01
-21.7331681E-01-28.1638504E-04 14.7726693E-01  0.             0.             0.           -21.2402515E-01-28.9624781E+01
-21.7331681E-01-28.1638504E-04 14.7726693E-01  0.             0.             0.           -21.2402515E-01-28.9624781E+01

    FTRA           FTRB           FTRC           MTX            MTY            MTZ            FXM            FYM

-38.4004004E+02  0.           -15.0673604E+04  0.            16.0406606E+04  0.           -38.4004004E+02  0.

    FZM            LM             MM             NM

-15.0672379E+04  0.            16.3730353E+04  0.

      VPCS

38.7489900E+02

      TFFS

 0.             0.
```

```
                                                          T(I)
              0.                   0.

      SAC1

  32.4694654E-03 29.9097614E-03-12.9297512E-02  0.            0.            75.9107567E-04  0.

      FLEX

       POINT           XD2F           XD2T           YD2F           YD2T           ZD2F           ZD2T           XD1F
       XD1T            YD1F           YD1T           ZD1F           ZD1T           XD0F           YD0F           Z00F

  10.0000000E-01  0.             -34.9888331E-01  0.              0.             24.1990600E-01-36.7176720E+00  0.
  28.9808246E+01  0.               0.            -50.5692372E-02 10.6839430E+00  0.              0.            -54.1456083E-03
  20.0000000E-01  0.             -30.4054562E-01  0.              0.             41.2149001E-01-34.0861784E+00  0.
  28.9450583E+01  0.               0.            -35.8349573E-02 94.3170673E-01  0.              0.            -32.1843903E-03
  30.0000000E-01  0.             -22.0057782E-01  0.              0.            -38.1980995E-01-37.0031921E+00  0.
  28.9697607E+01  0.               0.             38.6691460E-02 31.8093557E-01  0.              0.             35.9658674E-03
  40.0000000E-01  0.             -89.7090109E-02  0.              0.             50.2130542E-01-24.2742351E+00  0.
  28.9810314E+01  0.               0.            -64.2441212E-02-32.8972980E-01  0.              0.            -65.3568100E-03

                                                      LANDING RCLL
                               ISS =  1          ILR = 1          ICS = 0          IBS = 1
     AUTS

     TI            TR

  18.9500000E-02 19.1725800E-01

                                                    PITCH AUTOPILCT

     DELON          ALPHAE         ALPHD1         ALPDD1         ALPHET         DELODE

  30.6287623E-01 23.4068797E-02-18.8350368E+00  0.             23.4068797E-02 80.0000000E-01

 INTEG RTN.      HT =  2.00000000E-03
 INTEG RTN.      HT =  4.00000000E-03
 INTEG RTN.      HT =  2.00000000E-03
 INTEG RTN.      HT =  4.00000000E-03
 INTEG RTN.      HT =  4.00000000E-03

      2SOF

  21.5675000E-01 21.5675000E-01 62.9736031E+01  0.             69.7018358E-01 28.9718678E+01  0.             64.1566697E-02
   0.           -17.2920983E-02  0.             25.9511409E-02 28.9719388E+01 99.7358071E+00 28.9719382E+01  0.
  63.1051099E-03 12.6878268E-02  0.            -10.2219518E+00  0.            -12.4789772E-03  0.             11.4398411E-02
   0.              0.            -14.9026962E-01  0.            -33.7704377E+00 12.4671000E+04  0.              0.
   0.              0.

      LGEAR
```

```
                               SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                    GENERALIZED COMPUTER PROGRAM

                      INDSDF  2      CASE LROLL        STAGE  1      PAGE    180
      DELTA            P               P2              FT              SR              SF              AA              FC2

 14.7549808E-02 21.8555862E+04  0.                    26.0137060E+03-84.0357874E-01-26.0402750E+03-53.7833859E-01-26.3765748E+02
 13.1049272E-02 24.4403636E+04  0.                    64.8406385E+03-69.7437837E-01-63.8864657E+03 35.0852115E+00 14.1194492E+02
 13.1049272E-02 24.4403636E+04  0.                    64.8406385E+03-69.7437837E-01-63.8864657E+03 35.0852115E+00 14.1194492E+02

      MUVP             VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

 61.0323709E-03 36.7034593E-02-15.8746787E+02  0.                    -26.0105883E+03-14.2932152E+02  0.             14.7549508E-02
 50.3812992E-04 30.3009505E-03 32.6679498E+01  0.                    -64.8414200E+03 32.6745072E+01  0.             13.1049272E-02
 50.3812992E-04 30.3009505E-03 32.6679498E+01  0.                    -64.8414200E+03 32.6745072E+01  0.             13.1049272E-02

      SD2              SD1             S               S2D2            S2D1            S2              OMETD1          OMET

-45.9558532E+00 43.9149888E-01 12.1725279E-01  0.               0.              0.             -59.5550634E+01-32.0196011E+01
-40.6310273E-01-18.2700061E-02 14.7304548E-01  0.               0.              0.              41.8903939E+00-28.8659956E+01
-40.6310273E-01-18.2700061E-02 14.7304548E-01  0.               0.              0.              41.8903939E+00-28.8659956E+01

      FTRA             FTRB            FTPC            MTX             MTY             MTZ             FXH             FYH

-62.3265216E+01  0.           -15.5694983E+04  0.             53.9761547E+04  0.             -62.3265216E+01  0.

      FZH              LH              MH              NH

-15.5825061E+04  0.            54.9198671E+04  0.

      VPCS

 38.7489900E+02

      TFFS

  0.              0.

                                                                   T(I)
                  0.              0.

      SAC1

 32.4740443E-03 31.9584782E-03-15.5999937E-02  0.               0.              81.3424480E-04  0.

      FLEX

      POINT            XD2F            XD2T            YD2F            YD2T            ZD2F            ZD2T            XD1F
      XD1T             YD1F            YD1T            ZD1F            ZD1T            XD0F            YD0F            ZD0F

 10.0000000E-01  0.            -26.8621334E-01  0.              0.              52.0443808E-01-44.5501221E+00  0.
 28.9731687E+01  0.              0.           -31.2409478E-02 77.0712491E-01  0.              0.             -75.2283216E-03
 20.0000000E-01  0.            -18.2126043E-01  0.              0.              63.7688256E-01-40.5940384E+00  0.
 28.9394659E+01  0.              0.           -46.4985768E-03 66.6170683E-01  0.              0.             -42.8699949E-03
 30.0000000E-01  0.            -12.2857373E-01  0.              0.             -64.1191925E-01-39.1341503E+00  0.
```

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                                   SIX DEGREES OF FREEDOM FLIGHT PATH STUDY
                                        GENERALIZED COMPUTER PROGRAM

                         INDSOF  2      CASE LROLL        STAGE  1      PAGE    181

28.9622156E+01  0.                 0.          93.3717172E-03 24.4072809E-02  0.               0.                   48.5894487E-03
40.0800000E-01  0.            -46.7671489E-02   0.                0.          83.3030695E-01-13.3271829E+00    0.
23.5734005E+01  0.                 0.         -25.7293336E-02-52.0683265E-01  0.               0.                  -86.6326757E-03
                                                         LANDING ROLL
                                ISS =  1            ILR = 1            ICS = 0           IBS = 1
    AUTS

    TI              TR

18.9500000E-02 19.6725000E-01

                                                         PITCH AUTOPILOT

    DELQN           ALPHAE          ALPHD1          ALPOD1          ALPHET          DELODE

30.6287623E-01 23.4068797E-02-10.2219518E+00  0.              23.4068797E-02 80.8000000E-01

INTEG RTN.        HT =   4.00000000E-03
INTEG RTN.        HT =   4.00000000E-03
                                         TIRE DEFLECTION EXCEEDED           DELTA(1) =   1.9851551E-01
INTEG RTN.        HT =   4.00000000E-03
      2SOF

21.7975000E-01 21.7975000E-01 63.6399140E+01  0.              69.6921565E-01 28.9679579E+01  0.              -52.2063271E-02
 0.           -16.1657556E-02  0.             25.9476171E-02 28.9680049E+01 99.7087269E+00 28.9680049E+01   0.
17.3451870E-03-10.3258883E-02  0.            -97.6940394E-01  0.            -34.3054527E-04  0.              -10.6690377E-02
 0.              0.           -19.1914853E-01  0.            -34.6742941E+00 12.4671080E+04  0.                0.
 0.              0.

    LGEAR

    DELTA           P               P2              FT              SR              SF              AA              FC2

19.8515506E-02 31.7986145E+04  0.             36.6323315E+03-20.1305943E+00-36.6393341E+03-14.1752777E-01-12.2416074E+02
12.7079334E-02 24.0289790E+04  0.             62.0851985E+03-55.2885932E-01-61.0777885E+03 37.0427561E+00 31.3247865E+02
12.7079334E-02 24.0289790E+04  0.             62.0851985E+03-55.2885932E-01-61.0777885E+03 37.0427561E+00 31.3247865E+02

    MUVP            VGPT            FTRX            FTRY            FTRZ            MA              MB              DDELTA

81.3367200E-03 48.9196841E-02-29.7997004E+02  0.            -36.6374504E+03-25.3119011E+02  0.              19.8515506E-02
71.5619046E-04 43.0435197E-03 44.4288748E+01  0.            -62.0845338E+03 44.6141728E+01  0.              12.7079334E-02
71.5619046E-04 43.0435197E-03 44.4288748E+01  0.            -62.0845338E+03 44.6141728E+01  0.              12.7079334E-02

    SO2             SO1             S               S2O2            S2O1            S2              OMETO1          OMET

-53.7220752E+00 29.9161937E-01 13.0307516E-01  0.              0.              0.            -10.5466255E+02-33.9242808E+01
-66.0056317E-02-27.2128405E-02 14.6779439E-01  0.              0.              0.             57.1976575E+00-28.7499972E+01
-66.0056317E-02-27.2128405E-02 14.6779439E-01  0.              0.              0.             57.1976575E+00-28.7499972E+01

    FTRA            FTRO            FTPC            MTX             MTY             MTZ             FXM             FYM
```

```
-23.9082630E+02  0.          -16.0802345E+04  0.          91.6673590E+04  0.          -23.9082630E+02  0.
     FZH           LH              HH           HH
-16.0871776E+04  0.          92.7250028E+04  0.
       VPCS
 38.7489900E+02
       TFFS
  0.               0.

                                                        T(I)
                  0.              0.
       SAC1
 32.4756652E-03 31.4782995E-03-16.7418423E-02  0.          0.          83.4035137E-04  0.
       FLEX
      POINT          XD2F            XD2T          YD2F          YD2T          ZD2F          ZD2T          XD1F
      XD1T           YD1F            YD1T          ZD1F          ZD1T          XD0F          YD0F          ZD0F

 10.0000000E-01  0.           -30.2521441E-01  0.                 0.          57.5920501E-01-55.0322660E+00  0.
 28.9692663E+01  0.             0.           -18.0918797E-02 61.9441236E-01  0.              0.          -80.9378365E-03
 20.0000000E-01  0.           -17.1282435E-01  0.                 0.          33.0058761E-01-52.8990147E+00  0.
 28.9376594E+01  0.             0.            74.5418512E-03 52.2395910E-01  0.              0.          -42.4284041E-03
 30.0000000E-01  0.           -14.9072448E-01  0.                 0.         -41.6198318E-01-37.1119852E+00  0.
 28.9589256E+01  0.             0.           -37.8307236E-03-10.1878645E-01  0.              0.           49.1455111E-03
 40.0000000E-01  0.           -11.0338983E-01  0.                 0.          57.3910599E-01-91.4330084E-01  0.
 28.9694528E+01  0.             0.           -84.7199163E-03-58.3370543E-01  0.              0.          -92.4719438E-03
                                                  LANDING RCLL
                               ISS =  1        ILR = 1        ICS = 0        IBS = 1
     AUTS
      TI             TR
 18.9500000E-02 19.9025000E-01
                                                  PITCH AUTOPILCT
      DELON          ALPHAE          ALPHD1        ALPDD1         ALPHET        DELODE
 30.6287623E-01 23.4060797E-02-97.6940394E-01  0.           23.4060797E-02 80.0000000E-01
```

STOP